AMERICAN MACHINIST

October 30, 1940

For the Railroad—*Welding and riveting combine for economic production in A C F's new hopper cars*

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THE CARE AND FEEDING OF 75's

The 75-mm. gun, most useful artillery piece, is also one of the greatest consumers of ammunition. Hence the making of 75-mm. shells is one of the vital firsts in America's defense program. It was also first in American Machinist's series of Armament Sections—now appearing in every issue. Here are typical comments about the first of these practical up-to-the-minute handbooks:

> Please arrange to send us six additional copies of "How to Machine 75-mm. Shell" . . . Address the reprints for my personal attention . . .
>
> H. H. Pinney, *President*,
> E. W. Bliss Co.

> . . . We are very much interested in both of these articles (75-mm. shell—Sept. 5 and Tanks—Sept. 18), as we have a Tank order and a shell order in our defense program . . .
>
> F. J. Lamborn, *Vice-President in charge of Mfg.*,
> Chrysler Corp., Dodge Division

> The article, "How to Machine 75-mm. Shell," is excellent, and we should very much like to receive an additional 25 copies if they are available.
>
> Thor M. Olson, *Vice-President*,
> Ex-Cell-O Corp.

> The special article . . . "How to Machine 75-mm. Shell" . . . is a very complete article on the subject . . .
>
> W. C. Westbrook,
> Noble & Westbrook Mfg. Co.

> We will appreciate it very much if you will send us a reprint on "How to Machine 75-mm. Shell" . . .
>
> L. M. Quan,
> Fayette R. Plumb, Inc.

Demand has been so great that this section is already out of print, but copies are still available of subsequent sections on Tanks, Cartridge Cases, Heat-Treating Munitions and Welding Munitions. If you anticipate armament orders, ask for extra copies *now*. And read each subsequent section as it appears in AMERICAN MACHINIST—always first with the latest metal-working data.

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WHAT'S IN THIS ISSUE

THE OLD GRIND

Now and then even the best precision grinder, equipped with the right wheel running at the proper speed, will act up and turn out plenty of spoiled work. Nine times out of ten improper wheel dressing is to blame, but finding out what's improper about the established technique is usually something else again. So, with industry groaning under the load of production pressure, with high precision, we feel that H. J. Wills' advice on dressing grinding wheels will be more than welcome. Mr. Wills, as you may already know from previously having made his acquaintance in these pages, is an engineer associated with the Carborundum Company. His article, which begins on page 859, is the first in a series of three.

SENSIBLE

We've seen engineering departments go wild over a particular process, using it for outlandish applications at what must have been tremendous cost. The passion for "all-welded" construction sometimes has put welding in the class of fads. So it was with real pleasure that we came across an example where the designers admitted quite frankly that they used welding where it was cheapest, riveting where *it* was cheapest. This is possibly the highest tribute that could be paid to the art of welding—the process has survived the experimental, skeptic, repair, occasional, and fanatic phases — to emerge victorious as an accepted production tool, to be used unhesitatingly where needed, to be forsaken where too expensive. The application we have in mind is not in a consumer product where price is everything, but in heavy equipment where strength and durability count as heavily as cost—railroad freight cars. On page 862 J. W. Sheffer, of American Car & Foundry, explains why, and how, some 100 hopper cars were fabricated by both welding and riveting.

FIRST LINE

Possibly you think of battleships (long accepted as our first line of defense) solely in terms of guns and armor plate; and while we'd never dispute the persuading ability of a sixteen-inch gun, we'd like to focus attention for a moment on the machinery that puts the ships and their armament in the strategic spot at the right time. We refer to propulsion machinery in general and turbine reduction gearing in particular. For those who wonder why it takes years to build a battleship, we recommend "Geared for Defense," on page 874 of the AMERICAN MACHINIST Armament Section. In it A. A. Ross, of General Electric, outlines some of the steps in making these essential ship components.

RED END

Past the red end of the spectrum lies the infra-red, and past page 866 appears the end of the series of articles on infra-red in industry. In case you have the impression infra-red is useful only in paint drying, John Sasso, author of the series, points out many other applications of the process. Even assembly operations come within its province. But let Mr. Sasso, associate editor of *Product Engineering*, tell you the story: "Versatile!" A man of few words. We print his picture only because the cut was crowded out of the issue containing the first article, and we hate to throw it away.

JOHN SASSO
. . . digging out data

FIRST LINE (ALT.)

There are those who argue that our traditional first line of defense is no longer first but second, with its place now occupied by the airplane. We are not convinced, but we do recognize the tremendous importance of planes, and the urgent need for boosting their output. One of the most vital links in the production chain is the precision parts supplier. Not only must he produce many parts to specification, but often must develop and manufacture complete units. Torn between production pressure and demands for precision, he occupies an unenviable position in the defense program. On page 876 R. J. Wenger, shop superintendent at Bendix Aircraft, gives an idea of the many headaches.

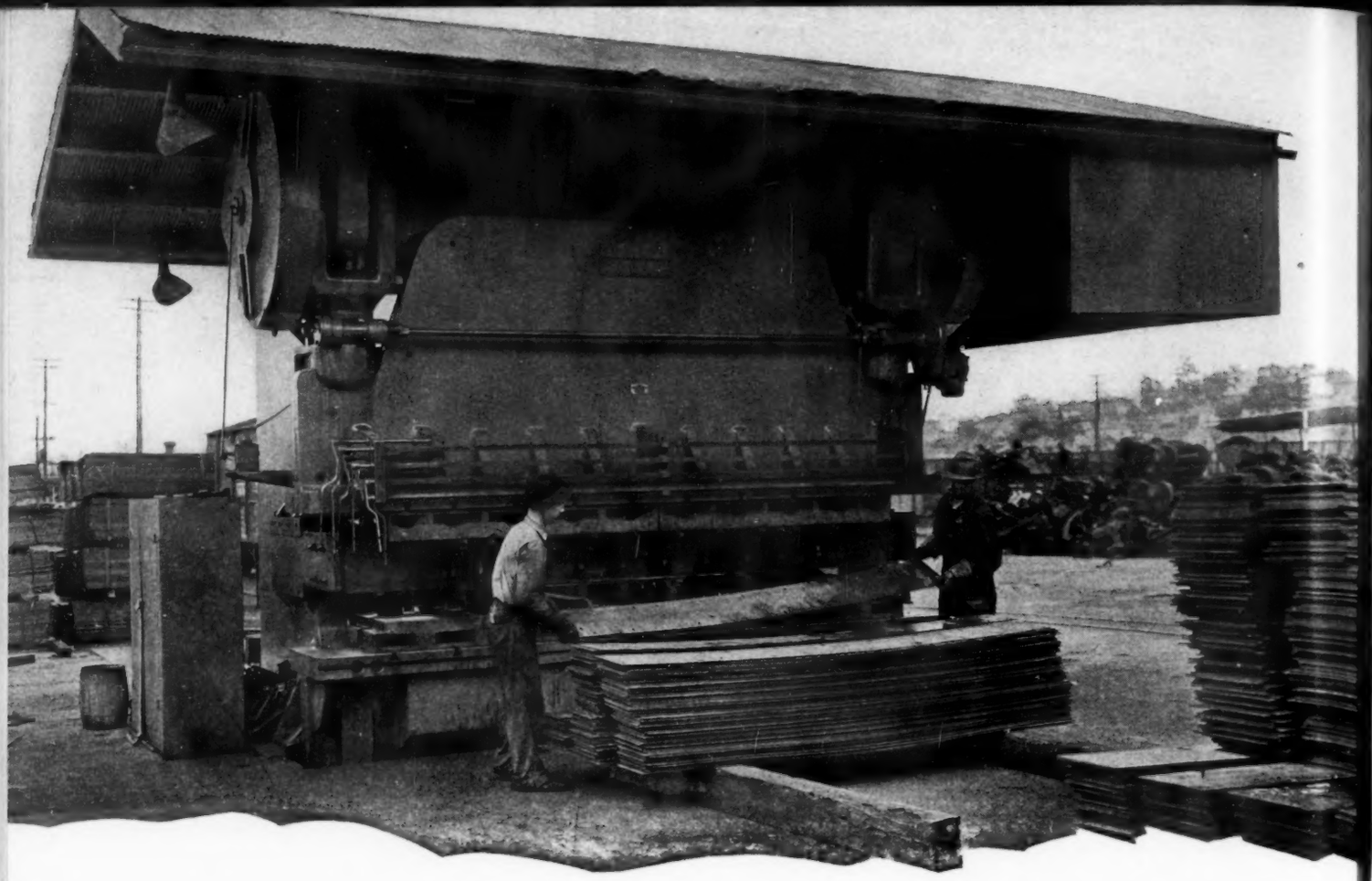
R. J. WENGER
. . . headaches, headaches

WHO MAKES FOR DEFENSE?

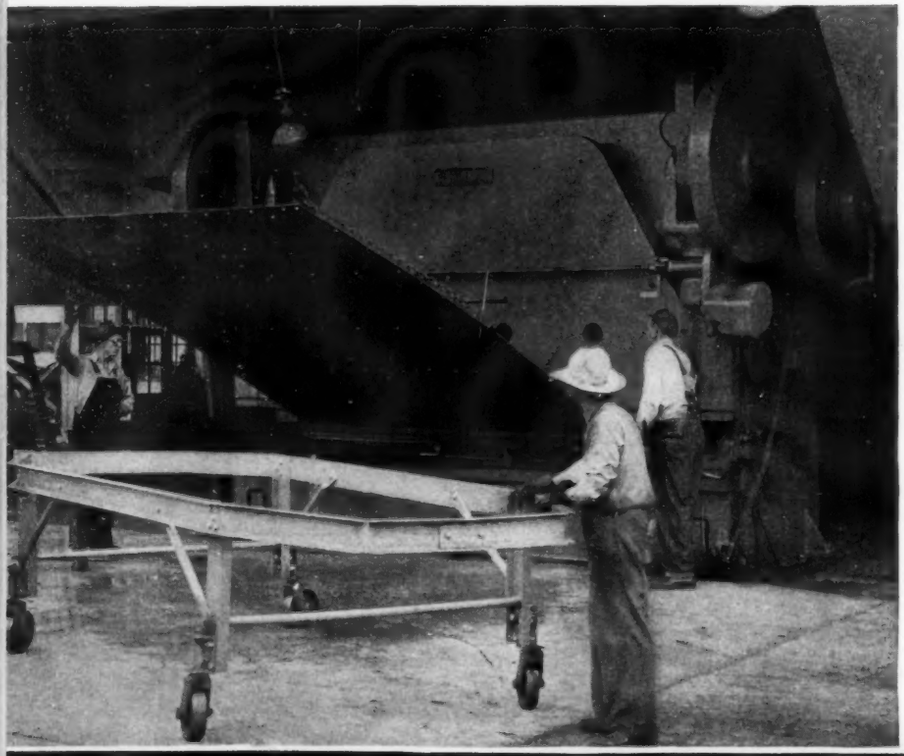
Who's got the contracts the Government's been awarding for national defense items? What are they for? How much is involved? When are deliveries scheduled? Offhand, the answers to these questions would seem to involve a statistician's nightmare. But they're not as bad as that. For believe it or don't, all that information has been squeezed into ten pages, beginning on page 879.

COMING

How's production on the Garand rifle coming along? What are some of the special operations involved? These and many other questions about the manufacture of this new weapon will be answered in an early Armament Section. Also scheduled are articles on copper brazing, carbide tools for steel, multiple-sheet profiling, and other phases of metalworking vital to defense. Look for them soon in AMERICAN MACHINIST.



Paid For Itself In Four Months



ON one job alone, required for the rebuilding of 1800 hopper cars, the above recently installed 400 series Cincinnati All-Steel Press Brake completely refunded the investment in four months.

● ● ● ● ●

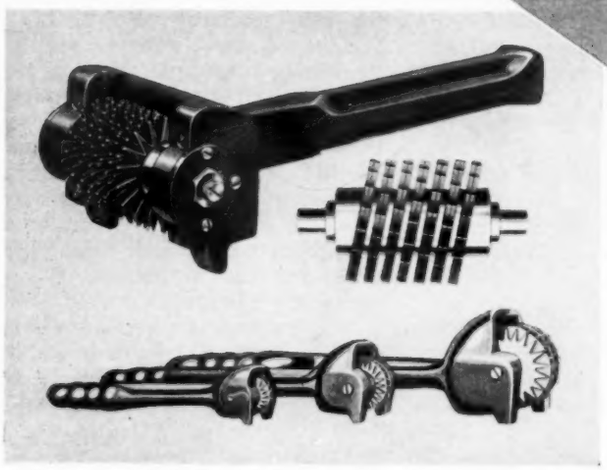
At the left is another CINCINNATI PRESS BRAKE working for a railroad. Job illustrated—bending end on hopper chute. Records show that this unit has refunded the investment at least four times during its 3 years of service.

Every plan for modernization or new car construction should include the economies which can be effected with Cincinnati All-Steel Press Brakes.

Write for recommendations on your job.

THE CINCINNATI SHAPER COMPANY, CINCINNATI, OHIO

DRESSING AND TRUING GRINDING WHEELS —No. 1



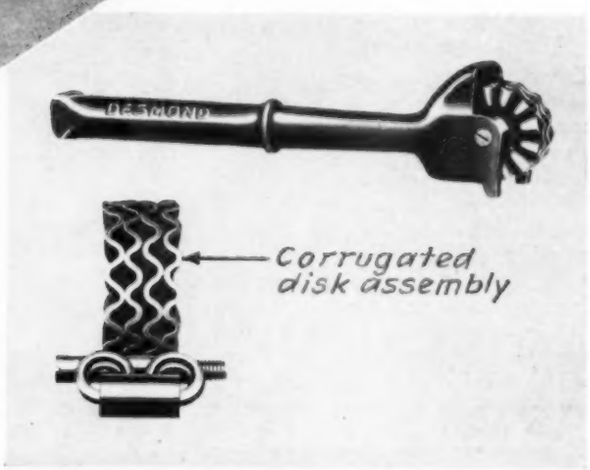


Fig. 1—(Left) Suitable for segmental surface grinding wheels, and for coarse grit wheels used for snagging and off-hand grinding, the Huntington dresser must be used carefully for best results. Fig. 2—(Right) The corrugated-disk dresser is used to smooth the faces of roughing wheels in many shops

Tools make the wheels go round

BY H. J. WILLS, ENGINEER, THE CARBORUNDUM COMPANY

A grinding wheel must be kept sharp like any other cutting tool. Also its shape must be correct. Here are some of the tools for truing and dressing

WHEN USED in connection with grinding wheels, the terms *truing* and *dressing* often are used interchangeably because the processes are similar. The real difference is in the purpose. Truing restores a wheel's concentricity and parallelism, or alters its shape. Dressing changes or maintains its cutting action.

While grinding wheels are more or less "self-sharpening," one which never needs dressing will wear too rapidly for economy, and will be too soft to give good finishes or economical production. A wheel well-suited to the job must be dressed often enough to keep it sharp—otherwise production will suffer. Dressing also restores the desired cutting action when the face of the wheel has become loaded with metal or other foreign material.

For production grinding, wheels should be dressed at regular intervals, whether or not there is apparent need for it. The period between dressings for each type of work should be determined by tests. If the wheel is permitted to become obviously dull or loaded before it is dressed, production will suffer; and because excessive wheel material must be removed at each dressing, its life will be shortened. Dressing and truing should be standardized as to frequency, tools used, and methods.

The Huntington, or *star,* dressers shown in Fig. 1 efficiently remove metal filling. It is suitable for segmental surface grinding wheels and for coarse-grit wheels used for snagging and off-hand grinding. It is inexpensive, but requires skill on the part of the operator for proper use.

The corrugated disk dresser, shown in Fig. 2, is similar to the star dresser, but because it will not give a very

open structure it is used solely to smooth the faces of roughing wheels. Fig. 3 shows a locked-disk type dresser which will true the face of the wheel flat and open the bond only slightly. Its use is limited to medium roughing wheels, but it has a wide field in dressing wheels for centerless grinding bars, bolts and similar products, and for cam and crankshaft grinding.

The Ross dresser shown in Fig. 4 is a solid steel cylinder whose surface contains one or two helical grooves or series of evenly spaced openings. This dresser takes the place of a diamond for jobs such as the fine grinding of cast iron, precision surfaces and finishes on tappets.

Abrasive sticks, either round for magazine mounting or square for hand use, are economical for truing and dressing wheels for roughing cuts, when a diamond is to be used to dress for subsequent finishing grinds. Either may be used to dress wheels for saw-gumming, tool sharpening, centerless profile grinding and for Blanchard surface grinder wheels.

The square abrasive stick is suited for toolroom wheels used for sharpening reamers, end mills and various other cutting tools. Magazine mounted sticks find use in forming wheels for profile grinding and for dressing and truing thin wheels.

A dresser which uses a silicon-carbide wheel as the dressing element is shown in Fig. 5. Such dressers often are used in place of diamonds for dressing wheels used for centerless grinding, where commercially fine surfaces are required. These dressers give the wheel a clean-cutting, smooth face which will not leave dressing marks on the work. Their use does not call for much skill. Since they commonly are used without coolant, the operator can watch the action closely. However, if the grinding is done wet, a coolant should be used when dressing. Abrasive wheel dressers of this type are set at a slight angle to the axis of the grinding wheel, and are driven by contact with the wheel.

Diamonds for truing and dressing grinding wheels are of several types, each having different characteristics. Fig. 6 shows the construction of three typical diamonds. From left to right they are *octahedron, elongated* and *Ballas* (round). These sketches show the two and four point grain structure, and the "Was" (pronounced *Vas*). The "Was" are flaky, unusable surfaces. Since the only usable parts of most stones are the points, the four point being the best, the diamond should be reset before the point is completely worn away. Once the point is worn away, the stone will wear much more rapidly and it will not properly dress the grinding wheel.

The decision as to when to reset a stone so as to expose a new point is chiefly a matter of judgment. Roughly, it should be done when the worn flat equals ten per cent of the exposed part of the stone. Gages for measuring this wear are available.

Diamonds are adversely affected by the heat generated when dressing grinding wheels. Also, overheating of the setting may cause the stone to loosen, which may result in costly diamond breakage or even total loss. For that reason, dressing always should be done with a copious supply of coolant. With the special holders shown in Fig. 7, the coolant flows around the metal directly behind the stone, thus keeping both stone and setting at a safe temperature.

If a diamond is presented to the wheel so that the wheel cuts directly across the lines of cleavage at a right angle, the stone will wear rap-

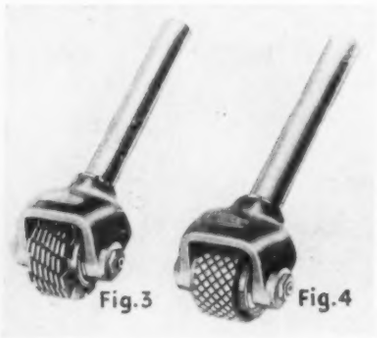


Fig. 3—Limited to medium roughing wheels, the locked-disk dresser will true the face of the wheel flat and open the bond slightly. Fig. 4—A solid steel cylinder whose surface is grooved, this dresser can be used in place of a diamond for dressing wheels used on precision work of all types

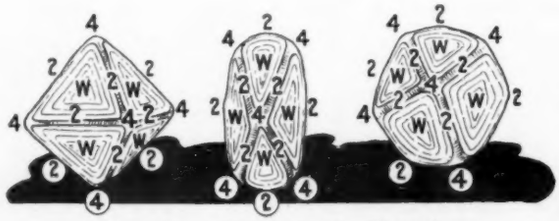


Fig. 6—Three typical diamonds used for truing and dressing grinding wheels. From left to right, they are octahedron, elongated and round stones

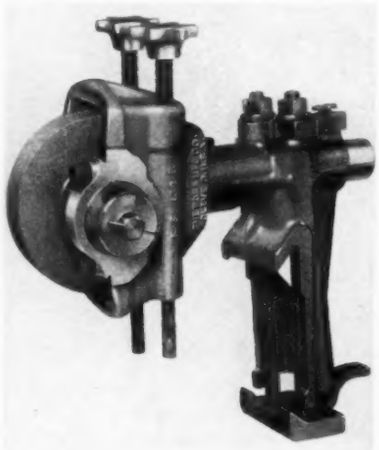
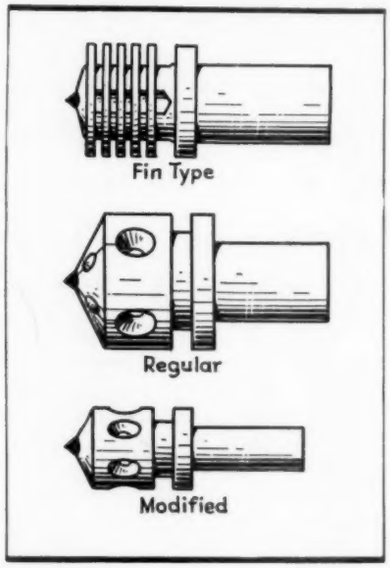


Fig. 5—Abrasive wheel dressers are driven by contact with the grinding wheel. Such dressers give the wheel a smooth, clean-cutting face which will not leave dressing marks on the work

Fig. 7 — Diamond holders of the types shown permit coolant to flow around the metal directly behind the stone, thus keeping both stone and setting at a safe temperature



idly, and may break. To prevent this, it is desirable to have the diamond approach the wheel at about a 60 deg. angle, so that the cutting action is along the line of cleavage. The holders shown in Fig. 8 permit such mounting, and so give a cool, clean cutting action.

To be fully efficient, an octahedral diamond must be reset to present a fresh point as soon as a point becomes dull. When all of the points have dulled, the stone is round and inefficient. Yet so much of the stone is left that there is a temptation to continue using it, even though the wheels are poorly dressed.

To secure even the limited efficiency that comes from utilizing the natural points by resetting is expensive. The total resetting cost may amount to a third or a half of the original cost of the stone. If the stone is set in molten metal, frequent resettings are apt to burn the diamond.

Tools are available which not only make resetting unnecessary, but permit practically complete consumption of the diamond while always having a sharp point or edge to apply to the wheel. Furthermore, since the original setting does not require the use of heat, the stone cannot be burned in setting. The setting can be ground by the wheel without weakening the support provided for the diamond.

The tool first is applied to the wheel at a slight angle, say 5 deg. When a flat develops the angle is increased, so that the ground edge formed in the first position is used. By frequently turning the stone and changing its angle, fresh points and edges are always available, without resetting, until the stone is entirely used up.

One tool which makes use of this principle consists of an elongated diamond set in a tungsten alloy. By mounting this tool in a special adapter, so that the tool is at a 30 deg. angle, and frequently rotating the nib on its axis, a sharp cone point is maintained. The entire stone can be consumed.

Another tool with an alloy setting which can be ground away, and which has the advantage of using small stones which cannot otherwise be completely consumed, is shown in Fig. 9. In this tool, several small stones are set in tandem. When the first stone is ground away, the next one is exposed by grinding or by turning the setting.

Another setting which permits the efficient use of small stones is shown in Fig. 10. Here seven small stones are set in a single plane in such a way that two to four are in contact with the wheel simultaneously. Each stone does its share of the work. The stones maintain sharp points, and the multiplicity of points gives a finer dressing action while maintaining the free cutting action of the wheel. The tool is turned frequently to present the other stones to the wheel.

Somewhat similar in theory and action is the tool shown in Fig. 11, in which three diamonds are set in line. When the stones are ground flat on one side, the tool is turned over. Thus sharp edges are always available.

Fig. 12 shows a dressing tool which consists of a matrix impregnated with small diamonds. It is applied to the wheel at a 10 to 15 deg. angle. As the tool becomes dull it is given a quarter turn. Such tools are used only for finish dressing, and are suitable for wheels of any size, type or hardness.

The second article in this series by Mr. Wills will appear in an early number.

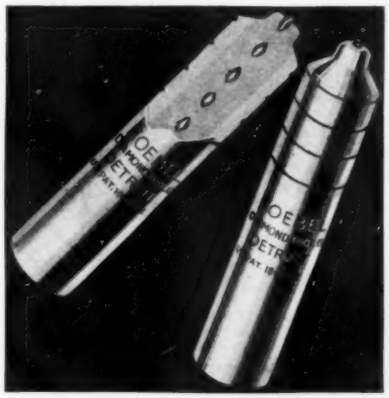


Fig. 9—Small stones are used economically in a tandem setting, such as the one shown. Stones are exposed by grinding away the setting

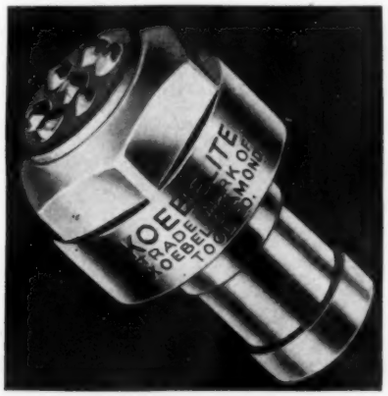


Fig. 10—Here seven small stones are set in a single plane in such a way that from two to four stones contact the wheel simultaneously

Fig. 11—With three diamonds set in line, this dressing tool is turned over when the stones are ground flat on one side

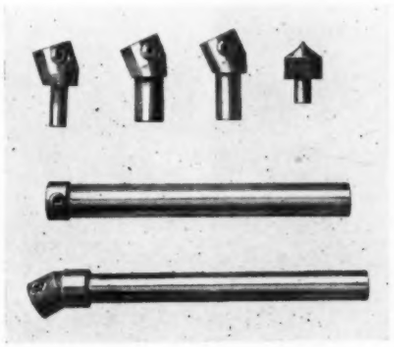


Fig. 8—These holders present the diamond dresser to the grinding wheel at a 60 deg. angle so that cutting action is along the line of cleavage

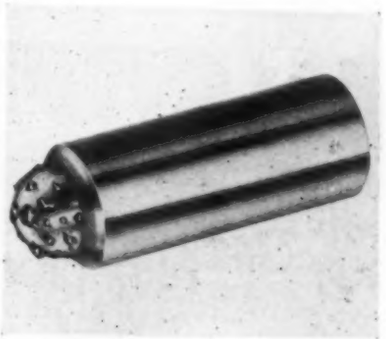
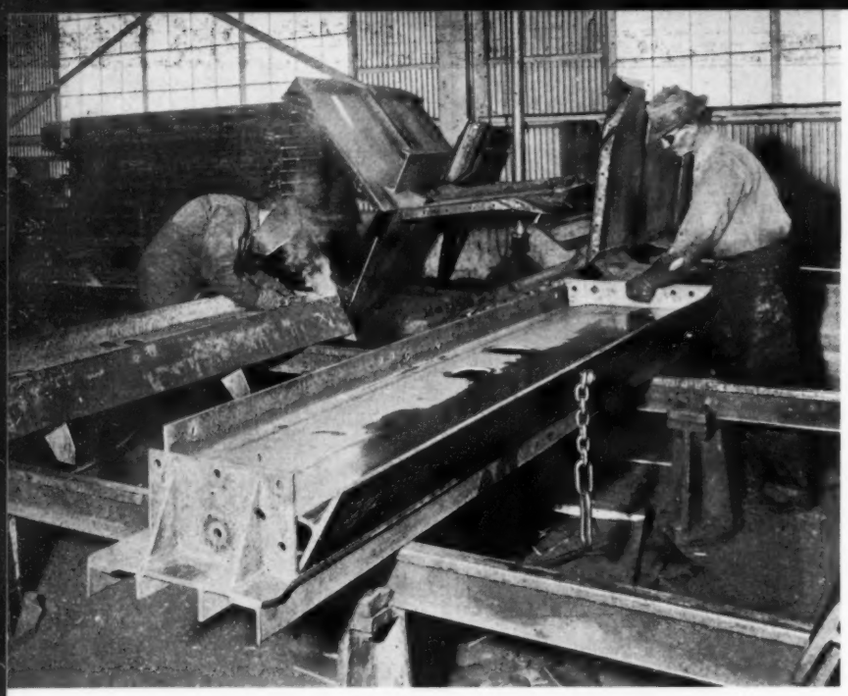


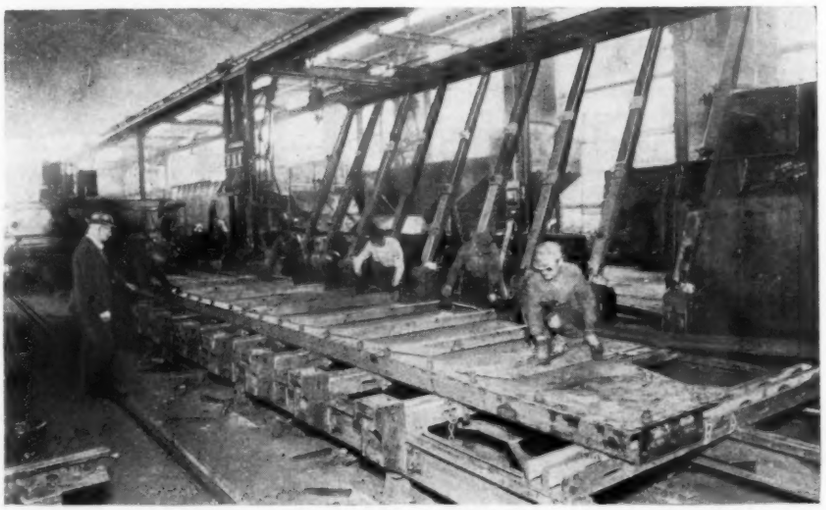
Fig. 12—A number of recently-developed dressing tools consist of a matrix impregnated with small diamonds. Such tools are used for finish-dressing all types of wheels



Low-cost

Combined welded and riveted construction of hopper cars makes quick repairs possible. Parts are jigged for hand and automatic welding operations

The bolsters, with web tilted so that the flange will conform to the slope of the end hopper sheets, are placed in jigs for welding side-bearing struts and side-connection plates; 36 lineal ft. of welding is used



The top and bottom side angles are placed in this jig, the side sheet bolted to the angles, and the side stakes positioned on the side sheets preparatory to automatically welding them in place. The automatic welding operation is in progress on an alternate jig in the left background

A gantry with two automatic welding heads supported from a travel carriage platform is used to weld both edges of the side stakes to the side sheet simultaneously. The welding head is thyratron controlled. Welding and rapid traverse movements are pushbutton controlled

freight cars

BY J. W. SHEFFER, AMERICAN CAR & FOUNDRY COMPANY

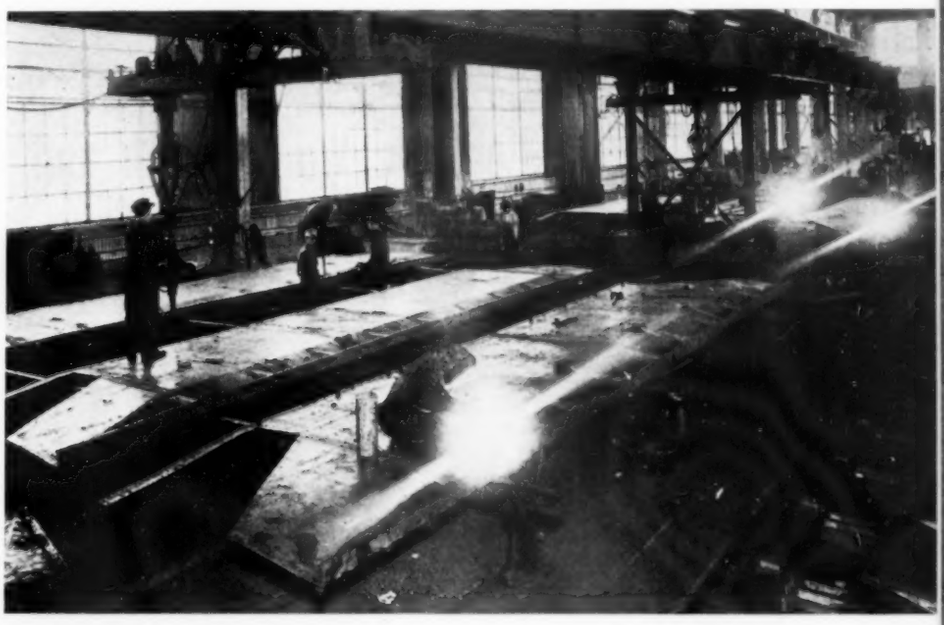
RECENTLY the Chesapeake & Ohio Railroad built 100 hopper cars of 50-ton capacity, using combined welded and riveted construction. The underframes, sides and ends were subassembled by welding, and riveted at their respective lines of attachment during final assembly. This method was adopted not only for economic reasons but also to speed production and facilitate repairs to side, end and floor sheets which are subject to severe corrosion during the service life of the cars.

The underframes, sides and ends were subassembled with the parts jigged in a flat position to avoid vertical and overhead welding. Much of the welding was accomplished with a gantry-type unit having two automatic welding heads supported from a travel carriage platform and properly positioned to apply single beads along the side sheets, and beads on two sides of each side stake simultaneously. The welding head of the machine is thyratron controlled, with pushbuttons for all welding and traversing operations. Hand welding was done with $\frac{1}{4}$-in. and $\frac{5}{16}$-in. shielded arc electrodes, while automatic welding was done with $\frac{3}{16}$-in. electrodes in reels mounted on the gantry unit.

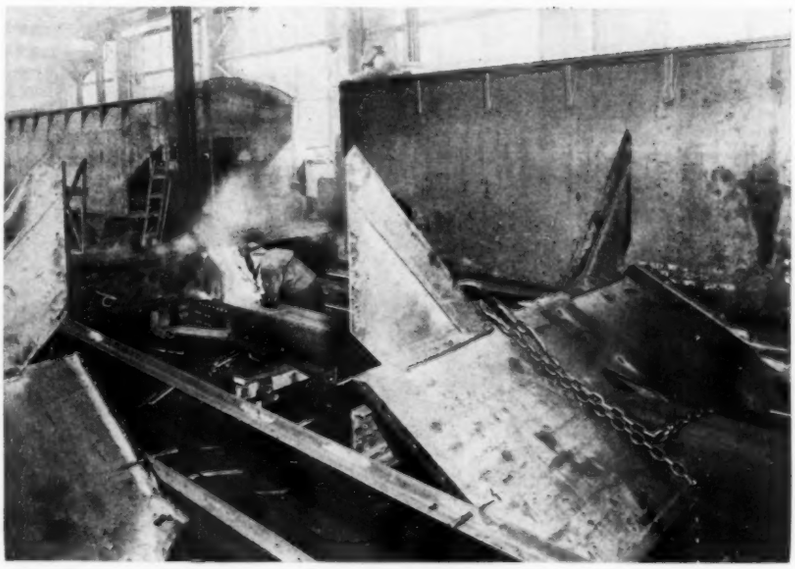
In final assembly, welding was used principally at joints in contact with the lading, and at upper flanges of center sills. Riveting was used at other locations. About 900 lineal feet of welding was used on each car, this being mostly butt and fillet welds of continuous and intermittent beads.

Light weight was not a prime objective in building the cars, and the weight saved by the use of welded construction was replaced by increasing the thickness of the floor and hopper sheets, which members are subject to greatest deterioration. Welding permitted the floor, center ridge and hopper construction to be made smooth, thus facilitating the flow of the lading. Maximum capacity without exceeding clearance limits were attained by welding pressed steel side stakes on the inside of the side sheets and by building up the end sheets in arch form.

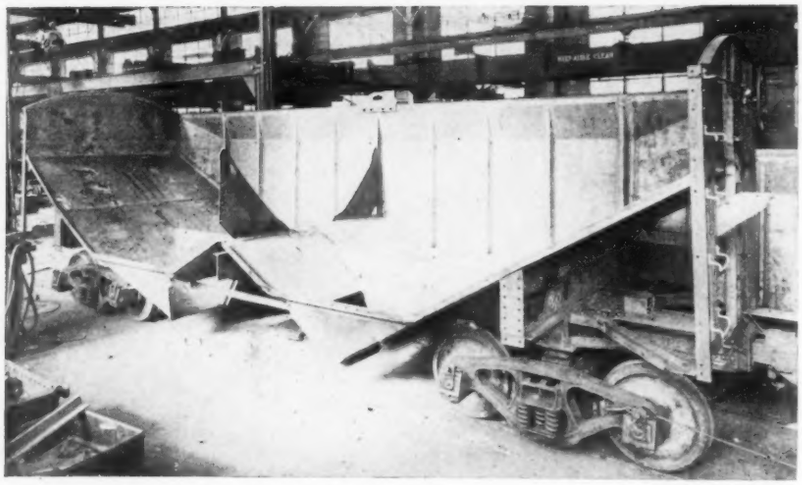
The center sill construction utilizes A.A.R. twin Z-bars weighing 41.19 lb. per ft. The bolster center fillers and rear draft lugs, as well as the striker and front draft lugs are of cast steel secured by rivets. The center plates are drop forgings held by rivets. Each body bolster is a 21-in. 59-lb. H-beam, placed on the top of the center sill construction, having its



The side sheets, with bottom angle bolted in place, are welded, drilled, reamed and riveted in one of the subassembly operations. After the side stakes are welded to the side sheets, this subassembly is riveted to the underframe and ends



In the first main assembly position, the bolsters are fitted to the center sills, and the side-bearing braces, floor-post gussets, diagonal-brace gussets and air brake valve supports are welded in position. Finally, the cross-ridge subassembly is fitted to the end and center sills



At succeeding positions on the erection track, the sides and ends are applied, as well as miscellaneous items such as corner caps, sill steps, ladder stiles, hand brakes, steps, and stake closures. Parts of the cars subject to severe corrosion are riveted to facilitate replacement when necessary. Most major subassemblies are of arc-welded construction

top flange tilted to the angle of the end floor sheets. The cross-ridge construction was built up as a unit including the inside bracing, its final application to the car being mainly by rivets. The hopper doors are of pressed steel and so shaped to obtain a tight closure.

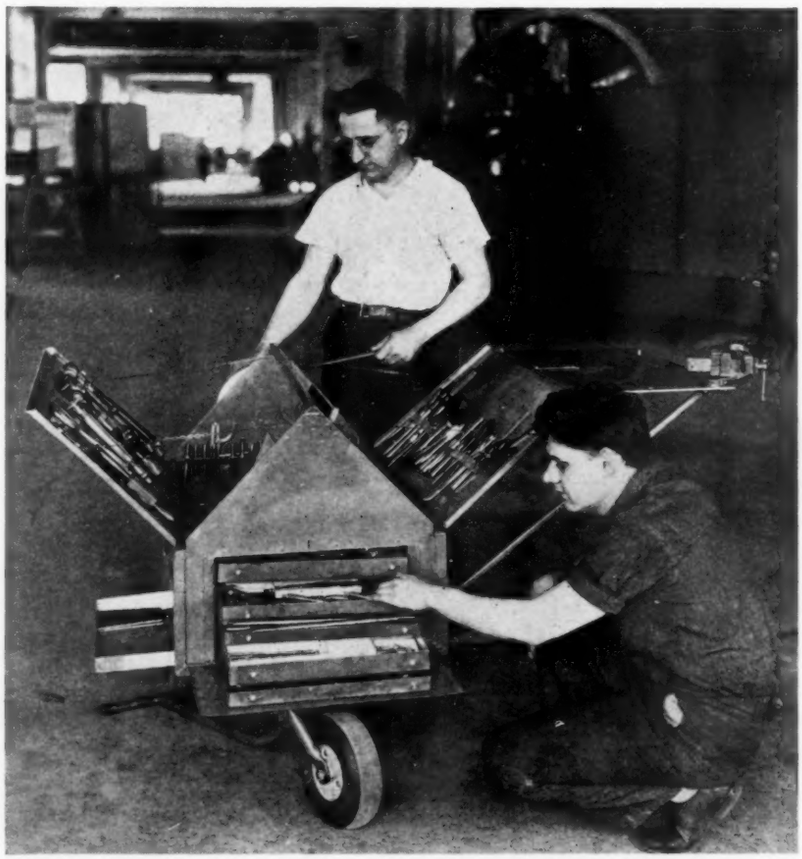
The principal dimensions and weight of the cars are as follows: Length over strikers—53 ft. 11¾ in.; length inside—33 ft.; center-to-center of trucks—24 ft.; width over-all—10 ft. 5 in.; width inside—10 ft. 4 in.; height over rail—10 ft. 6¼ in.; capacity—50 tons and 2,081 cu.ft. level full; light weight—41,500 lb.; load limit—127,500 lb.

This outline of welded-riveted hopper-car construction illustrates the economics which must be considered by the designer, by the shop in its assembly of the cars, and by the railroad in its future repairs.

Portable Work Bench and Tool Box

AIRCRAFT PLANTS are often confronted with the necessity of working on airplanes on the flying field or in the hangar. Some of this work may involve installation or removal of parts which have been riveted into the structure. The problem is to get the necessary tools for the mechanic and his helper out to the airplane. Not only must the quantity of tools be so complete as to save unnecessary trips back to the shop but provision must also be made for power operation of some of these tools. The cart shown in the illustration was developed at Wright Field to take care of almost every contingency in connection with working on every part of the airplane except the engine.

Mounted on three air-filled rubber-tired wheels the cart has one drawer in which are kept sheets of various thicknesses of aluminum alloy for possible reinforcing jobs, other drawers containing gages, scales, drills and smaller tools. Screw drivers, shears, hand drills and other tools are held by fabric strips inside the cover. Larger tools including those needed for riveting are kept inside the cart. A thick sheet of aluminum alloy is hinged to one of the covers so as to provide a small-sized bench. Square tubing, which is normally carried inside the cart, is used to brace the bench. A reel on the back carries 100 ft. of cable for making connections to the power supply.



Every tool needed for making installations or repairs on the structure of an airplane has a place in this cart, the top of which forms a convenient work bench. The cart is made of welded and riveted sheet metal and may be closed to be moved from shop to flying field or hangar

Merely posting notices forbidding pranks doesn't relieve an employer of responsibility. He'll probably pay the bills if someone gets hurt

No horseplay!

BY LESLIE CHILDS

CONTENTED, CHEERFUL WORKMEN are assets to any industrial plant. So long as pleasant attitudes spring from a wholesome exchange of verbal badinage all may be well. But where exchanges of this kind take on the color of horseplay involving physical contacts, prudence counsels their discouragement. For if injury results, as is often the case, chances are that the employer will be held responsible.

Especially is this true where there is evidence that the employer made no effort to curb the prankish activities of his employees, and they became traditional in the plant. Courts take this into account, and an employer can rarely escape liability for injury arising from it. The danger in overlooking this phase of industrial management is illustrated in a long line of cases.

In one instance certain plant employees fastened an electric wire to an iron door, so that when anyone touched the door he would receive a shock. This prank had been played frequently on various employees under the eyes of a foreman, and the employer apparently enforced no rules against it. It was all done in fun—no harm to anyone was intended. But one employee suffered severe injury from shock when he came in contact with this door, and the court in affirming a judgment against the employer for the injury reasoned:

" . . . while ordinarily a master is not liable under the compensation act for injuries to a workman which have been caused through the mischievous pranks and sportive jokes of his coemployees, yet the rule is otherwise where the master has knowingly permitted such mischievous pranks to continue. In such case the danger of injury becomes an incident of the employment . . .

"The serious contention in this case is that the master did not know that such pranks were being perpetrated on its premises. It would not be unjust to say that the master should have known and was chargeable with notice, for the same mischievous and dangerous prank had been practiced frequently on other workmen off and on for several weeks or months before plaintiff was injured. Here . . . it was shown that plaintiff's foreman, the man who directed his work, was one of the perpetrators of the mischief which injured the plaintiff.

"This foreman knew this particular prank had become a custom on the employer's premises . . . and his knowledge of the electrical mantrap on the door was notice to his principal."

The importance of an employer's taking a stand against horseplay upon his premises is evident. But, to be effective, the stand must be positive. Mere posting of rules, unless enforced, will rarely avail an employer in defense against an action growing out of an injury of this kind.

For instance, another company announced rules forbidding horseplay by its employees while upon its premises. These rules, however, were not enforced effectively. Despite them, a workman suffered a fatal injury resulting from application of an air hose to his rectum by another employee. In holding the employer liable for damages, the court said:

"In appears from the record that during the forenoon of that day, and perhaps on other days, there had been 'horseplay' among the workmen. . . . It was stipulated by the parties on the hearing that 'the company did not tolerate horseplay,' and this stipulation is, of course, binding. There is evidence, however, from which the commission may have reasonably found that the supervision and discipline were lax and less than required by the type of men employed for the work and entrusted with the appliances being used . . .

"It is clear that injury occurred at a place where [the workman] was required by his employment to be, at a time while he was actually engaged in that employment and performing his duties as required by his employer; . . . he was therefore injured in the course of his employment. All of the causative factors of his injury were incidental to that employment, so that it must be held that the injury arose out of his employment."

The foregoing cases aptly illustrate the reasoning followed by the weight of authority in situations of this kind. In the light of this, an employer who knowingly permits horseplay by his employees upon his premises is, to say the least, taking uncalled-for risks. As proof, the law reports are freighted with cases of this kind, growing out of tricks, pranks and jokes, the consequences resting upon the employer since he pays the bills.

A box-section in one stroke

BY L. KASPER

AN ARRANGEMENT designed to form a sheet-metal box-section with each stroke of the press uses a forming punch of irregular shape and a cam-operated slide to move the pieces from one position of the die to the next.

The punch holder carries the forming and shearing punches and a cam, see Fig. 1 which shows the ram in the top position. A spring which is not shown in the drawing holds the roller on the slide against the cam face.

Material is fed into the die in the direction shown by the arrow, Fig. 1. As the ram descends the shear cuts the material to the proper length. The slide remains at rest until the roller reaches the incline on the cam when the slide is drawn to the rear by its spring. The wider portion of the forming punch forces the material into the wide part of the groove in the die forming a channel section. The distance between the two projections on the front end of the slide is such that the narrow section of the punch can pass through on the down stroke, see Fig. 2, and make the bends to finish the box-section.

As the ram ascends the roller moves on the incline toward the high spot of the cam causing the slide to move forward. The solid portion of the slide moves the channel-shaped piece forward under the narrow portion of the punch ready for the next down stroke of the ram. At the same time the projections on the front of the slide strip the finished piece off the punch as it rises. When the roller reaches the high point of rest on the cam the piece is completely stripped from the punch and drops through the hole in the bolster plate.

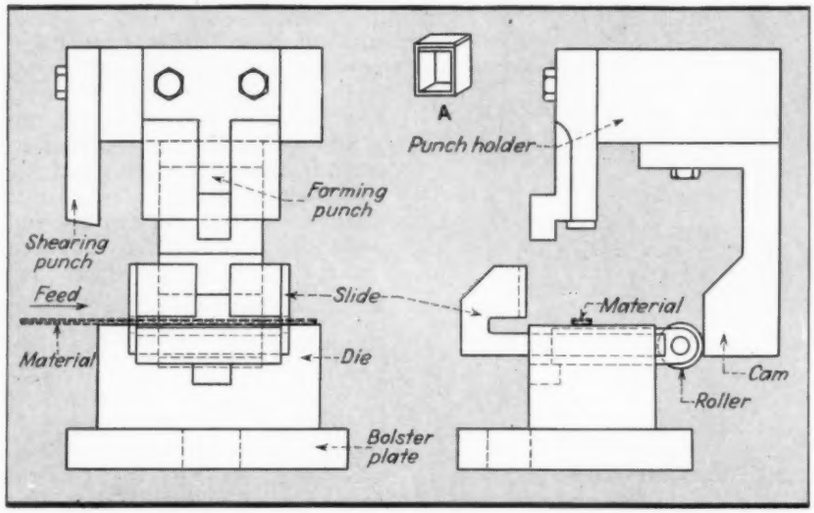


Fig. 1—Ram is in top position with material lying on top of die ready for forming into box-section in A. Stop, guides and stripper have been omitted to avoid confusion

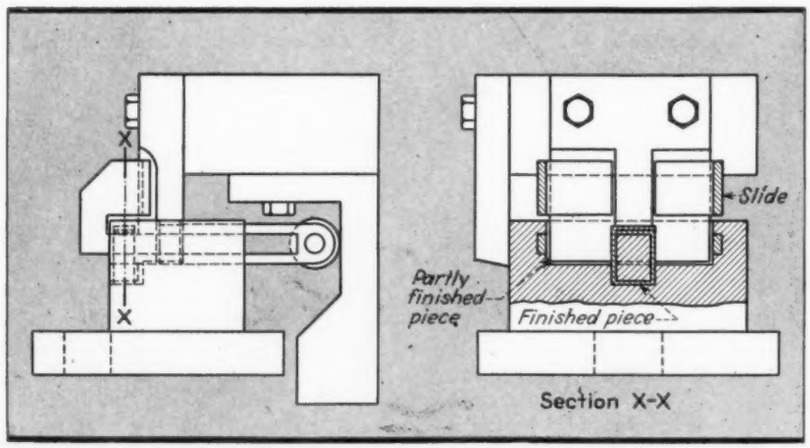


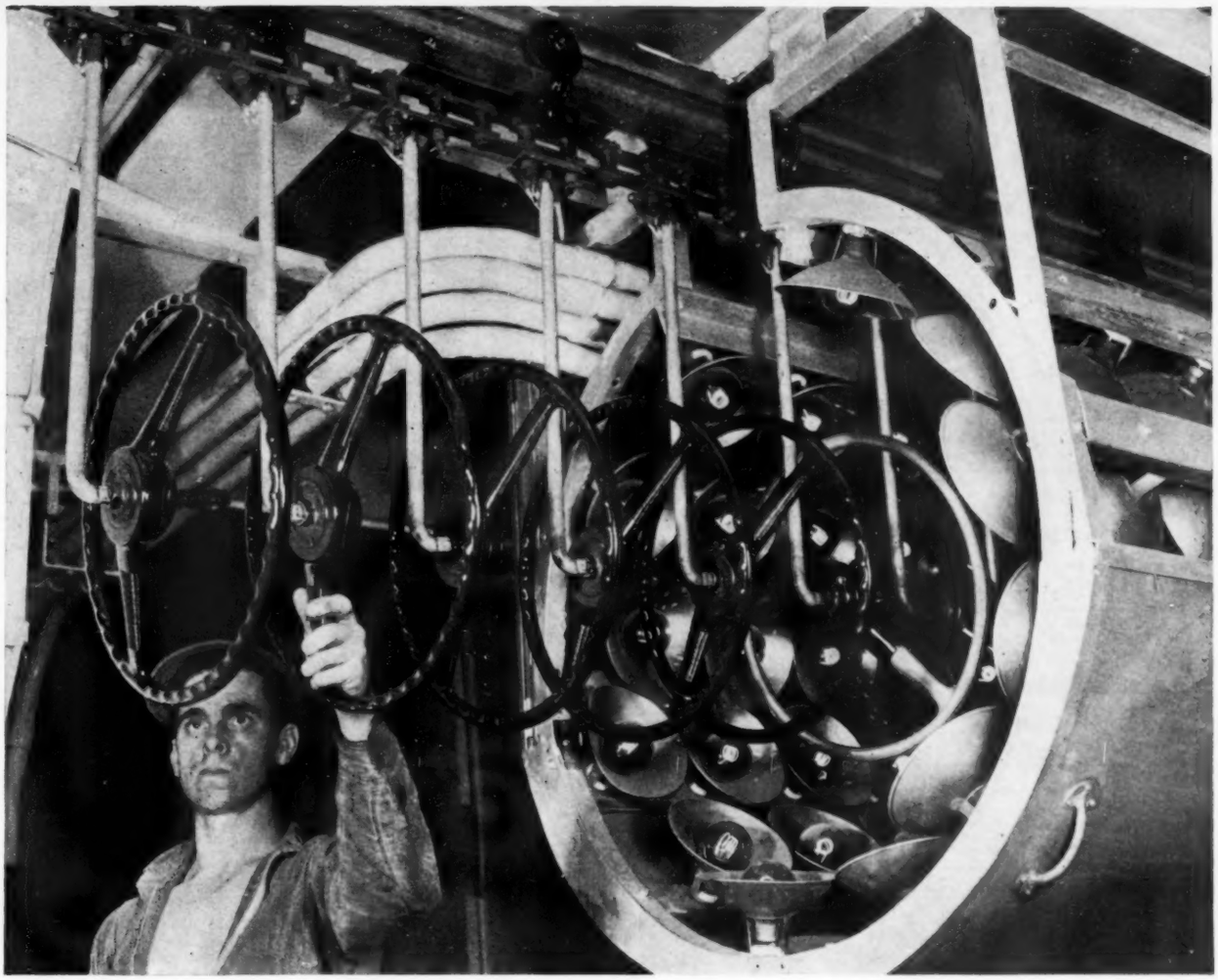
Fig. 2—Side view of the die with the ram down shows the finished piece on the front of the punch and the partly finished piece in the die under the wide rear portion of the punch

Belt Grinders

BY JOHN R. GODFREY

ABRASIVE belts are now so common that few realize how comparatively new they really are. Of course, the old buffing strap is ancient history. But the abrasive belt, running over two pulleys and supported under the work by a flat plate, belongs to this century. It was in the early 1900's that John C. Blevney phoned me to come and see him in his little shop in Newark. It was the same shop in which he built a few steam driven automobiles at about the turn of the century.

John was using sand paper at the time, which didn't seem practicable but did very well at that. Handing me a pointed steel rod he invited me to jam the point against the belt. Instead of ripping a slit in the belt as I expected, the end of the rod seemed to melt away like magic. This, to the best of my knowledge, was the beginning of what is now a standard machine. Sandpaper soon gave way to cloth backed abrasives, and these have also been greatly improved, as well as the machines.



Steering wheel finishes lend themselves readily to drying by radiant heat. This infra-red tunnel is used by the Ford Motor Company

Infra-red in industry

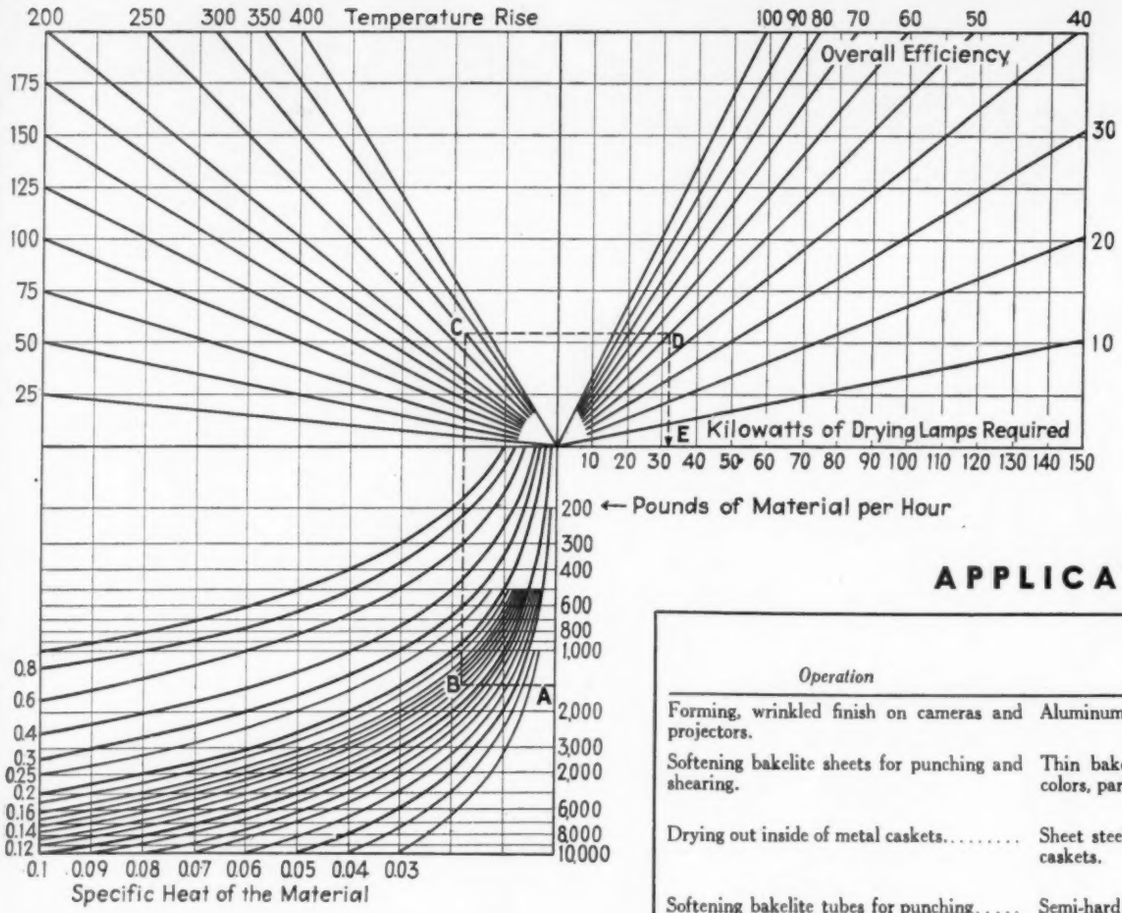
BY JOHN SASSO

Anyone who sits in front of an open fire knows the effect of radiant heat. If he reads this article at the same time he will learn of its growing application to metal finishes

FORD HAS USED infra-red heating in expanding pistons for inserting piston pins. One outboard motor manufacturer is reported to have used the method in making shrink fits. In the latter application, concentrating reflectors were found better than the parabolic type. However, much time was required by this method. Handling of plastic sheets has been simplified by softening them with infra-red lamps instead of in ovens prior to punching or forming. Fiber board is also successfully heated and softened prior to bending to shape. These are but a few applications of the principles of radiant heating discussed in a previous article (*AM*—Vol. 84, page 741).

Infra-red heating has the advantage over air or oven drying in that heat is instantly available with the lamps whereas some time is required to bring the parts and oven up to working temperature. The prime coat on Ford bodies is baked in fifteen minutes with infra-red lamps as compared to sixty minutes required by a steam oven that was replaced. Finishing coats require about twice as much time as prime coats with even greater saving over previous oven drying schedules. Comparisons of baking times between lamp ovens and conventional ovens may be misleading since often there are special conditions which favor one method against the other.

It has been pointed out by the American Gas Association that any baking results obtained with electric infra-red lamp equipment can also be obtained with gas equipment at a comparable cost and, it is claimed, with certain definite advantages. Ra-



Approximate kilowatts of lamps required for mass heating. Starting with the weight of material at A *proceed to specific heat* B, *vertically to the temperature rise* C, *across to overall efficiency of lamp bank* D *and down to the kilowatts required* E

diant gas burners have satisfactorily dried white urea-formaldehyde finishes, usually difficult to dry successfully with electric equipment.

Usually lacquers and quick-drying enamels can be dried rapidly. Occasionally, however, it is just as difficult to eliminate the slight tack of synthetic lacquers as it is to bake a true baking enamel because of the time required for oxidation. The fast-drying enamels best suited for lamp drying are made with short oil modified alkyd (glycerol phthlate) resins which may be further modified with urea-formaldehyde resins if greater hardness is desired. If high enough intensities are available, non-drying alkyd and urea-formaldehyde combinations are useful.

Space saving with infra-red heating may amount to as much as 50 per cent. A 15-kw. infra-red installation of 250 watt lamps required a floor space of about 30 sq. ft. as compared

APPLICATIONS OF

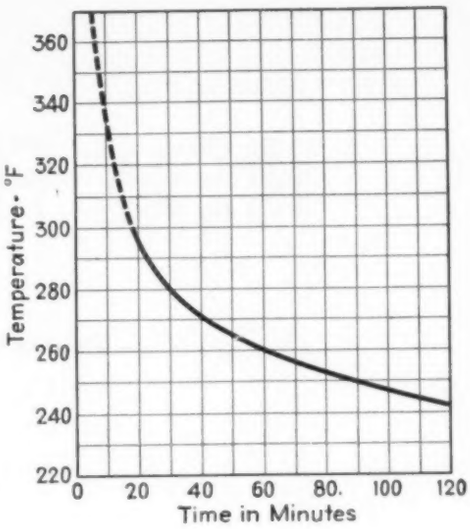
Operation	*Material*
Forming, wrinkled finish on cameras and projectors.	Aluminum die-cast metal.....
Softening bakelite sheets for punching and shearing.	Thin bakelite sheets, black and tan colors, parts punched out.
Drying out inside of metal caskets.....	Sheet steel pressed and welded burial caskets.
Softening bakelite tubes for punching.....	Semi-hard bakelite.....
Baking out radio coils and transformers....	Electrical coils and windings on fiber or bakelite cores.
Enamel baking on small metal stampings...	Sheet metal display with pressed pocket for advertising.
Removing cyanide from pits and pores in castings.	Gray cast iron.....
Baking finish on transformer cases.....	Pressed sheet steel boxes (22 gage)....
Drying adhesive lacquer or glue on speaker cones.	Steel frame and paper cones.....
Laboratory use — baking finishes on cans..	Tin cans, labels and decoration printed directly on tin.
Expanding pistons to permit dropping pins in place.	Aluminum alloy pistons.....
Softening bakelite for punching and shearing.	Bakelite strips from which small parts are punched by press.
Drying paste to hold jewels in place.....	Plated brass and die cast metal.....
Baking enamel finish on globe valves.....	Cast or wrought iron and brass.....
Baking wrinkled finish on die-cast auto heater cases or frames.	Die-cast frame or case for auto hot water heater.
Baking enamel on molded bakelite radio cabinets.	Small portable radio cabinet of molded bakelite — mottled brown color.
Baking out synthetic urea formaldehyde enamel on metal.	Test samples of steel sheet.....
Drying ground coat preparatory to firing on at high temperature.	Steel sheet.....
Drying first finish coat on fired ground coat..	Steel pan with vitreous ground coat fired on.
Baking synthetic enamels on small axe blades.	Steel axe blades.....
Dehydrating or drying Tenite preparatory to molding.	Tenite (a plastic) granules, various grades and colors.

* From investigations of radiant energy heat made by the Commonwealth Edison Company.

to 64 sq. ft. for a 15-kw. strip heater oven. Flexibility is secured by cutting banks of light in and out as required; and lights are adjustable to any direction. Distance of the lamps from the parts is usually adjustable for the full effective range of the lamps. Small banks of reflectors are mounted on rollers and used for spot drying of finishes in both automotive and aircraft manufacture and maintenance. Initial cost of infra-red installations is comparatively low. Maintenance is confined to replacement of lamps and cleaning reflectors. Further, the installations can be dismantled and rebuilt to suit new requirements.

The time of baking paint is shortened by increasing the temperature; but since most organic pigments tend to fade at elevated temperatures, caution must be exercised. (Graphs are from a paper by Howard Haynes, Nela Park Engineering Department, General Electric Company, before the Illuminating Engineering Society)

Information and data used in this article are based on information by Howard Haynes, General Electric Company; H. J. Bennett, the Glidden Company; Eugene R. D'Olive, Commonwealth Edison Company; Hale A. Clark, Michigan Consolidated Gas Company.



RADIANT ENERGY HEATING*

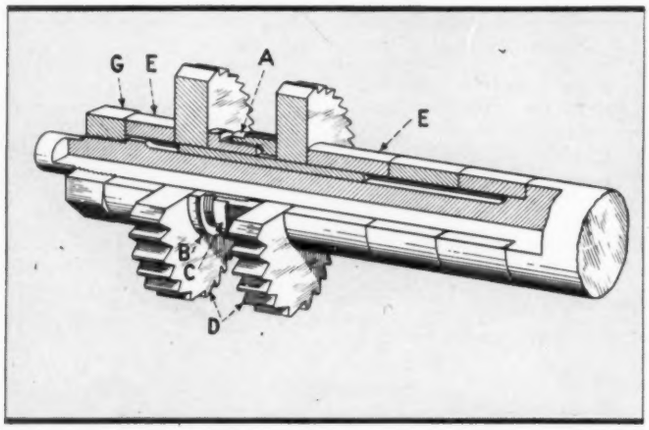
Size in In.	*Finish*	*No. and Size of Lamps*	*Total Watts*	*Reflector Diameter and Spacing In.*	*Reflector Finish*	*Distance in In. of Filament From Work*	*Time Under Lamps*	*Watts/Sq. In. on Work*
2 x 4 x 6	Synthetic plastic wrinkle finish sprayed on.	4 — 250W Tungsten	1000	8 1/4 dia. 9 1/2 spacing	Alzak	8	6 min.	2.75
3 x 4 ft. 1/8 thick	None — softening.....	16 — 240W Carbon	3840	8 1/4 dia. 8 1/2 spacing	Alzak	12 to 24	3 1/2 sec. Cont. after 2 min. preht.	0.9
16 x 24 x 72 Approx.	Plated or oxidized surfaces from which moisture must be removed on inside.	10 — 260W Carbon	2600	None — special arrangement	None	3 to 8	5 to 10 min.	0.40
3 dia. by 16 x 1/16	None — softening.....	8 — 240W Carbon	1920	8 1/4 dia. 8 1/2 spacing	Alzak	12 to 18	Continuous after 2 min. preheat.	1.2
3 dia. x 2 long	Insulating varnish impregnation	16 — 260W Carbon	4160	8 1/4 dia. 8 1/2 spacing	Alzak	10 avg.	4 min.	1.6
4 x 6 x 1/32	Red enamel sprayed on.....	16 — 260W Carbon	4160	8 1/4 dia. 8 1/2 spacing	Alzak	12	12–15 min.	1.33
10–14 dia. 1 1/2 x 2 height	Plating after wash in cyanide and hot water.	24 — 260W Carbon	6240	8 1/4 dia. 8 1/2 spacing	Alzak	7 varied	20 min.	3.2
3 x 3 x 4	Black nitro-cellulose lacquer with solvent — 5 min. air dry, 10 min. under lamps, 10 min. air.	30 — 260W Carbon	7800	10 dia. 12 spacing	Gold	8	10 min.	3.50
6 dia. cones 3 height speaker	Nitro-cellulose adhesive lacquer.	88 — 260W Carbon	22880	7 1/2 & 9 1/4 dia. 7 1/2 & 9 1/4 spacing	Gold & Color Alumilited	8	Continuous — 2 ft. per min.	2.40
2–3 dia. 4–5 height	Enamels, lacquers, inks.....	3 — 260W Carbon	780	9 1/4 dia. 9 1/4 spacing	Gold	Not known	Laboratory use	Varied
4–5 dia. 6 height	None — Expanding metal operation.	4 — 260W Carbon	1040	7 1/2 dia. 7 1/2 spacing	Color Alumilited	6	3 min.	2.25
2–3 x 48	None — softening.....	16 — 260W Carbon	4160	7 1/2 dia. 7 1/2 spacing	Color Alumilited	14	Continuous after 2 min. preheat.	
1/2–1 dia. 1/16 thick	Jewelers' paste.....	2 — 260W Carbon	520	None—in inclosure	None	Not known	5 min.	Inclosed
Up to 1 1/2 valves	Green air dry enamel.....	8 — 260W Carbon	2080	8 1/4 dia. 8 1/2 spacing	Alzak	6–8	5 min.	2.75
10–12 dia. 4 1/2 height	Wrinkled finish enamel — grayish tan color — wrinkle formed in 3 min.	32 — 260W Carbon	8320	8 1/4 diameter 8 1/2 spacing	Alzak	10–12	9 min.	3.7
6 x 8 x 14 1/8–1/2 thick	Urea formaldehyde baking (220 F.) cream color.	32 — 260W Carbon	8320	8 1/4 diameter 8 1/2 spacing	Alzak	8–12	9 min.	3.7
3 x 6 (18 gage)	Synthetic enamel, urea formaldehyde, air-dry enamel — Chinawood, soya and meleic oils.	8 — 260W Carbon	2080	8 1/4 diameter 8 1/2 spacing	Alzak	12	7 min.	1.8
12 x 12 20 gage	Water solvent ground coat gray color.	24 — 260W Carbon	6240	8 1/4 diameter 8 1/2 spacing	Alzak	10	9 min.	2.6
7 1/2 x 15 x 4 1/2 deep — 20 gage	Water solvent white first finish coat.	24 — 260W Carbon	6240	8 1/4 diameter 8 1/2 spacing	Alzak	10	5 min.	2.6
3 x 5 3/4 Blade edge to 3/4	Gloss black synthetic enamel and thinner.	8 — 260W Carbon	2080	8 1/4 diameter 8 1/2 spacing	Alzak	12	15 min.	2.2
1 layer in pan 22 1/2 x 30 x 3 1/2	No finish — moisture removal..	8 — 260W Carbon	2080	8 1/4 diameter 8 1/2 spacing	Alzak	30	20 min.	0.8

IDEAS FROM PRACTICAL MEN

Adjustable Collar Aligns Straddle Mills Quickly

By S. M. ELONKA

Setting up a milling machine for a straddle milling job is usually quite tedious. After the cutters have been properly spaced and a cut is taken, it may be found that several thousands must be removed or placed in between the cutters. That means lifting the



An adjustable collar between straddle mills can be used for the precise setting of the cutters. Shims are eliminated, and set-up time reduced materially

milling machine arm, removing the nut, collars, and at least one cutter. Finally, it is difficult to find a shim or collar. Final adjustments often require the making and application of suitable shims.

The illustrated adjustable collar *A* eliminates such difficulty and permits rapid adjustment of the straddle mills. The collar consists of male section *B*, which has a calibrated knurled collar, and female section *C*. For maximum strength and minimum strain on female collar *C*, buttress threads should be used, preferably 16 threads per inch. If standard V-threads are used, the female collar will eventually expand due to lateral pressure and the wedging effect of the V-threads. After parts *B* and *C* of the collar are machined, graduated and knurled for easy manipulation, they should be case hardened.

If a key is used to hold the cutters on the arbor, then part *C* of the adjustable collar should be large enough to clear the key on the mandral.

The straddle mills *D* mounted on the arbor with solid collars *E* and with the adjustable collar *A* between the cutters, it is only necessary to loosen the nut *G* and adjust the knurled collar *B* to the desired number of thousands which are graduated on the collar. Thus, much time can be saved in adjusting the cutters.

Converting a Planer Into a Boring Mill

By C. C. HERMANN

The work shown in Fig. 1 should have been done on a large vertical boring machine. Since such a machine was not available in this shop, a 60-in. x 60-in. x 18 ft. Detrick & Harvey planer was fitted with the illustrated device to machine radii up 15 ft.

The work being machined consists of a die block support with a radius of 72 in., is 35½ in. high and has a chord of 72 in. It is cast steel and weighs approximately 400 lb. The curved surface must be rough machined and finished. Finally a series of grooves must be cut across it parallel to the axis so that the finished surface will resemble a gear. The estimated machine time using the device shown in 100 hours which compares favorably with estimates for the same job on a vertical boring mill.

The device is designed to convert the longitudinal motion of the planer to circular motion of the work. Although not entirely new, it is novel and can be applied to other reciprocating machines. Similar parts in the illustrations are shown by the same letters.

The work is shown at *A* mounted on a base casting

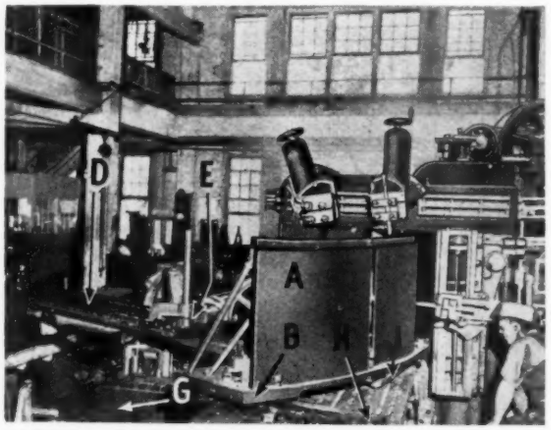


Fig. 1—This device, used for machining a die block support with a radius of 72 in., converts the planer motion to circular motion of the work

B and backing up member *C*. The base plate *B* is bolted to two 5-ft. T-iron sections shown at *D*. A pivot *E* is mounted on a base block *G* which in turn is secured to a bedplate permanently installed in the concrete floor. This bedplate is machined with T-slots so that the pivotal point can be moved to accommodate different radii. The radius may be adjusted from 4 ft. to 15 ft.

Parallel bars *H* are secured to the planer table for

the bottom of the base plate *B* to slide upon. A link *J* is pivoted to the base plate *B* at its center. The opposite end of this link pivots on the planer table.

It is obvious that as the planer table moves the fixture is pulled in the direction of motion by the link *J*. The fixture must move in a circular manner since it is pivoted at *E;* therefore, any point on the work face passes the tool at exactly the same distance from the pivot. In the case shown, the tool on the planer column is doing the work on the face of the segment; however, the top tool on the planer arm may be brought down to plane the top surface as well. The weight of the work is heavy enough to keep it down on the table, although provision is at hand to weight or fasten the fixture where this is not the case by laying weights on the ledge of the back plate *C*. The operation of the planer with respect to speed, feed and quick return motion is normal. The distance of bed travel is adjusted to the work requirements.

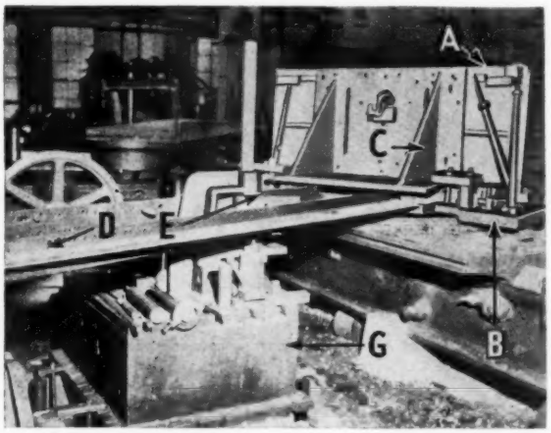


Fig. 2—As the planer table moves, the fixture is pulled in the direction of motion by the link pivoted at the base plate adjacent to the planer; therefore, any point on the work base passes the tool at exactly the same distance from the pivot

Improvised Boring and Threading Tools

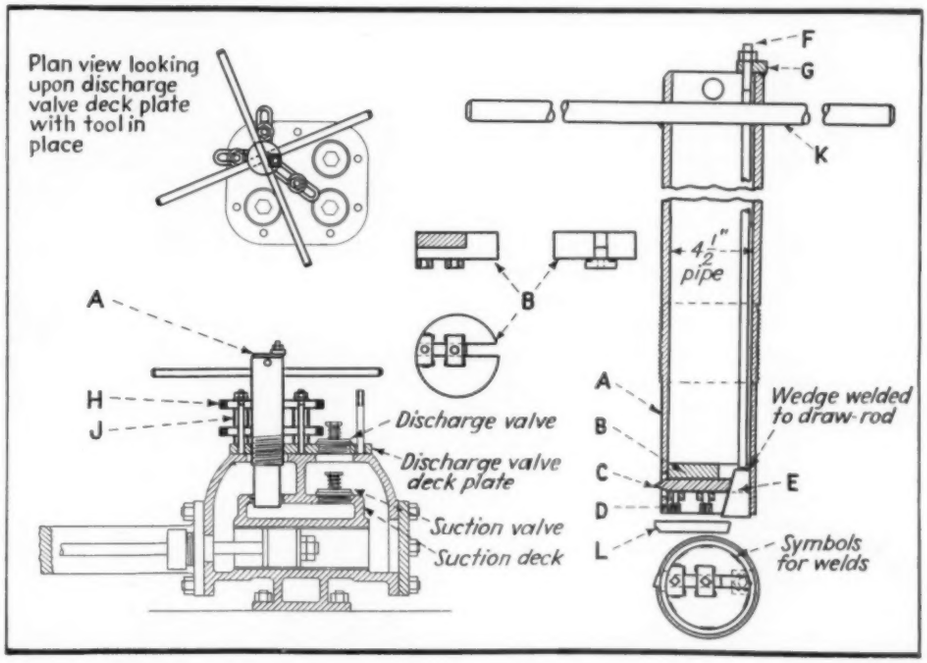
By EMIL WITTMANN

A suction-valve seat in the liquid end of duplex steam pump will jump out of its seat when the threads in the suction deck corrode. The tools shown in the drawing were designed and built to rethread the suction-valve seat without dismantling the pump.

With the head of the pump removed and the discharge valve seat above the defective suction valve taken out of the discharge deck plate, a piece of pipe *A* is threaded to fit the threads in the discharge deck plate. In the lower end of *A* is welded a disk *B* with a groove snugly fitting a tool bit *C* held by two setscrews *D*. The tool bit is clamped lightly by the two setscrews but permitted to be forced outward for controlling the depth of the cut by a wedge *E* located in a slot of *B* and actuated by a draw rod *F* extending through to the top of *A* through a guide piece *G* welded to *A*. With *A* screwed into the discharge-deck plate of the pump, strap clamps *H* are arranged in sets of three each as indicated and spaced by pipe nipples *J*. These serve as a steady rest for *A* which is revolved by hand using the handle bars *K*. When *A* is revolved, it feeds downward causing *C* to cut a thread of larger diameter but of the same pitch as in the deck plate.

Only few succeeding cuts are necessary to produce a full thread. Between the cuts, the tool bit is forced outward approximately 0.005 in. by tightening the

These boring and threading tools were designed to rethread the suction valve seat of a duplex pump, making it unnecessary to dismantle the pump while making repairs. The threads are cut in the suction deck as the threaded tool holder is advanced through the discharge deck

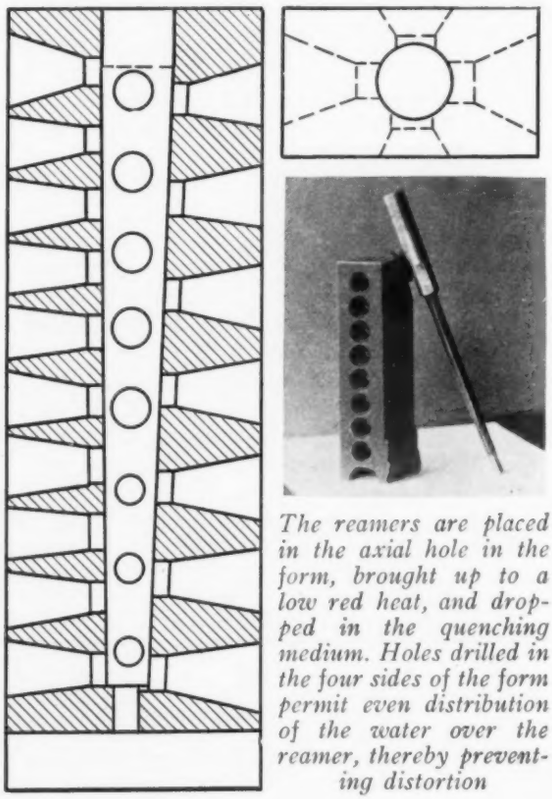


nut on top of *F*. A boring operation with a tool bit *L* precedes the threading operation. The threads on the outside of the suction valve are built up by brazing and the threads recut in a lathe to fit the threads in the suction deck.

Slender Reamers Not Ground After Hardening

By GEORGE J. MURDOCK

A considerable number of slender reamers are constantly required in one of our manufacturing operations. The cost of making the reamers had been so high by the common method of hardening and grinding the tapers afterwards that it was desired to reduce this expense without impairing the necessary accuracy. This was attained as follows:



The reamers are placed in the axial hole in the form, brought up to a low red heat, and dropped in the quenching medium. Holes drilled in the four sides of the form permit even distribution of the water over the reamer, thereby preventing distortion

A master reamer of the correct size—4½ in. long, 0.160 in. diameter at the top of the tapered part, and 0.140 in. at the bottom end, with a 0.125 in. pilot—was made with five cutting edges designed to make a shaving cut by milling the flats slightly concave the entire length of the taper. It was hardened, tempered and ground in the usual way.

A rectangular piece of machine steel, to be used as a hardening form, was then made somewhat longer than the taper part of the reamer. It was bored axially slightly smaller than the reamer, but to the same taper. The top of the hole was straight for a distance a little more than the length of the flats on the shank, and was made slightly larger than the shank. The hole in the bottom for the pilot was also enlarged slightly. The master reamer was then introduced into the bored hole, and the taper reamed until the end of the flutes above the pilot struck bottom.

Holes were drilled from all four sides into the central hole and countersunk nearly to the bottom. These holes were staggered so that they did not enter the taper from opposite sides but nearly midway between each other, those at the bottom being somewhat smaller than the ones at the top. After this hardening form had been completed it also was heat-treated to remove the strain due to machining.

A number of reamer blanks turned accurately to size but not hardened, were held in readiness after they had been stress-relieved by annealing to remove machining strains. One of the reamers was then tapped lightly into the form, leaving the part of the shank above the flat exposed about ½ in.

The form and reamer were then placed in a muffle, so as to exclude air, and brought to a low red heat after which the plug was knocked out and it was quickly dropped into cold water. On removing the reamer it was found nearly bright. The holder was a little discolored due to the inability of the oxygen in the air to reach it in the muffle.

When checked, the reamer was found to be as straight as before hardening, and of the required temper, the latter having been obtained by regulating the temperature of the water into which it had been dropped. When subjected to service the reamer lasted longer than those that had previously been ground after hardening, for grinding invariably sets up unequal strains on a ground surface.

After it had been found that a better and less costly tool could be made in this manner, several of the hardening forms were made so that six of them could be placed in the muffle at one time, thus further reducing the cost. Due to the comparatively low heat and the ease with which the hardening water entered the holes in the hardening form, it has been found that as many as 200 reamers could be hardened in a single form before it became necessary to renew it.

Since the successful application of hardening forms made on the principle described, it has been applied with equally good results to prevent distortion in a large variety of slender work that had formerly been ground after hardening, and with a corresponding saving in cost.

Rusted Sheets Repaired By Welding

By ARTHUR HAVENS

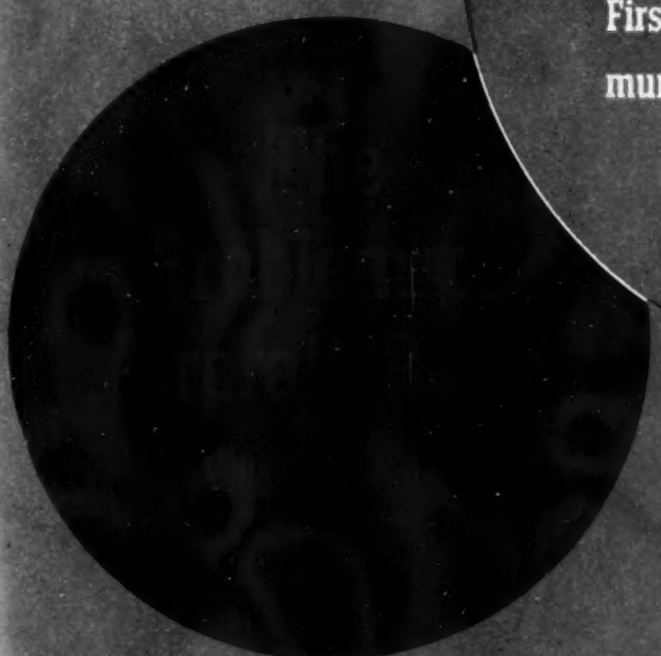
Rust will force the bottom of outside sheets on railway passenger cars outwards below the rivets. The sheets below the rivets can be removed by flame cutting, holding the torch parallel with the bottom edge of the sheet and ½ in. below the rivet line. Remove rust and slag and weld to the sheet a ⅛-in. band iron of the proper width. The weld can be ground flush and this area primed and painted, leaving no sign of the repair.

Armament

SECTION OF AMERICAN MACHINIST

DEFENSE CONTRACTS

First complete list of current U. S. munitions and aircraft orders placed with private industry

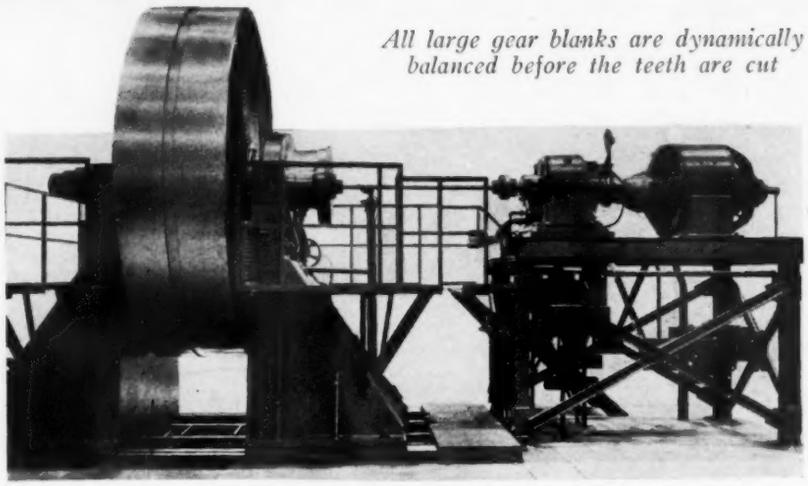


Geared for Defense

By A. A. ROSS

Gear Engineering Department, General Electric Company

GEARED FOR DEFENSE



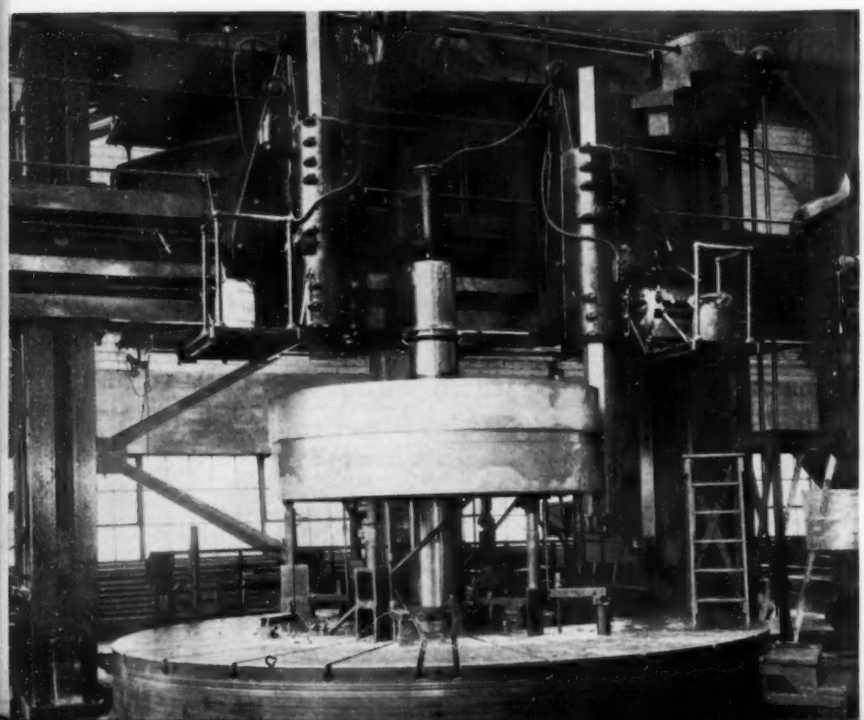
All large gear blanks are dynamically balanced before the teeth are cut

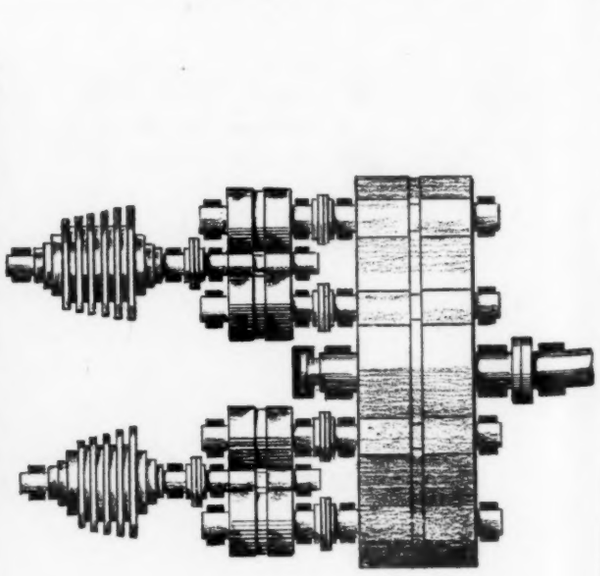
By A. A. ROSS
Gear Engineering Department, General Electric Company

BUILDING A TWO-OCEAN NAVY has turned the spotlight on every phase of ship-building. Not the least important is production of propulsion equipment. Most naval vessels now being built will be equipped with turbine-gear sets—turbines because they are the most efficient prime movers, gears because high turbine speeds must be reduced to slower speeds at which propellers operate most efficiently. For the manufacture of these gear reduction units, two shops at the General Electric Company plant in Lynn, Mass., are being expanded in a $3,000,000 program which will nearly double the company's reduction gear facilities.

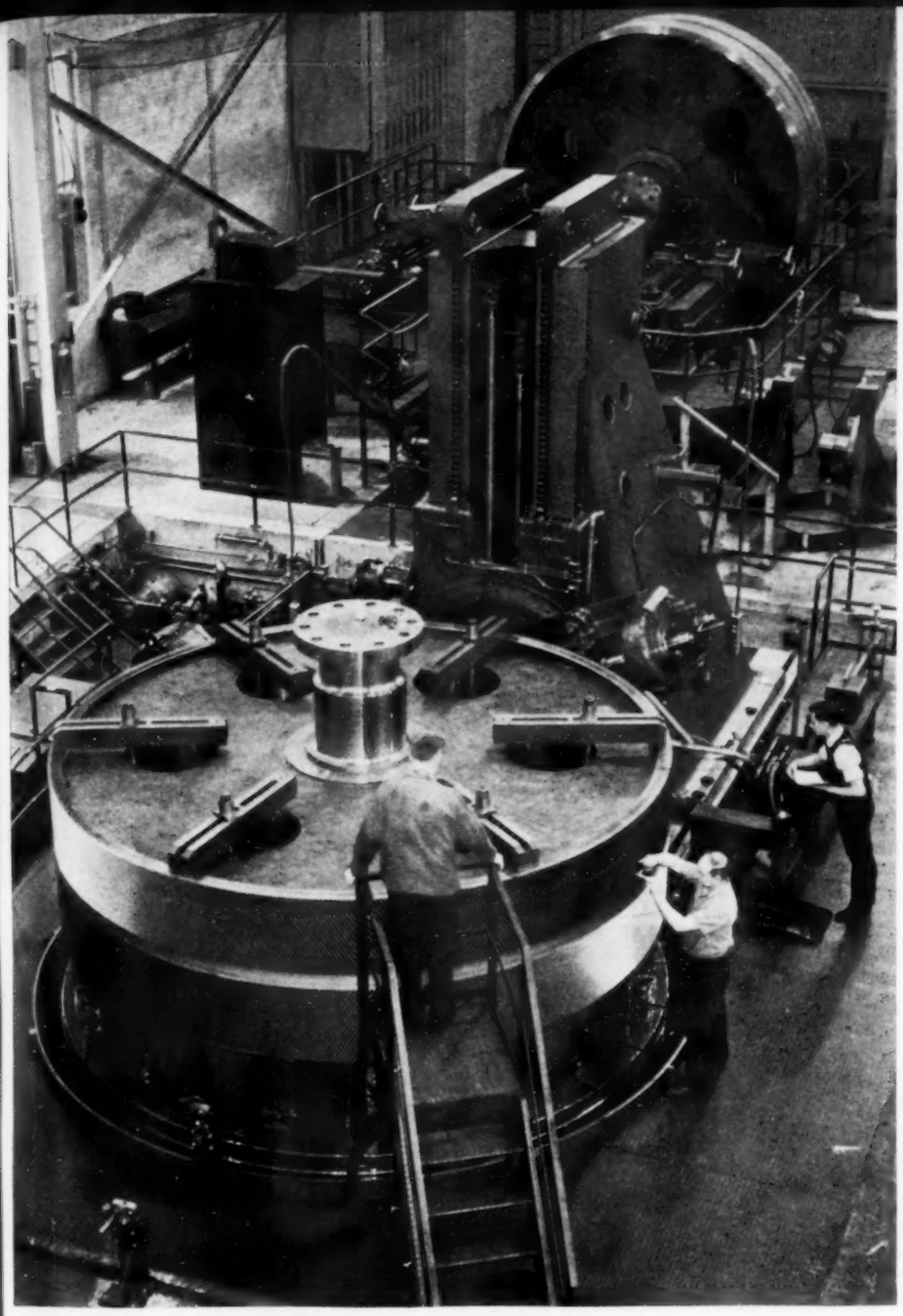
Major parts of a gear reduction set include one or more pinions, a large "bull" gear, and casing. The bull gear is made of six pieces—a hub, four disks, and a tire. The hub is a steel casting, the disks are rolled plates, and the tire is a steel forging. All are welded together and strain annealed. The shaft is a single forging, ground to a slight taper to match that in the hub. The two are assembled with a carefully controlled press fit. The gear is then machined on its own journals, balanced, and is ready for hobbing.

Hobbing is done in a shop where temperature is maintained within five degrees of 72 F. Gear blanks are not brought into the shop unless their temperature is approximately 72 F., being cooled or heated in an anteroom if necessary. Once inside the shop, the blank is finish machined and set up on the hobbing machine table. Actual cutting time runs as high as 85 hr. Once a cut is begun the machine is not stopped until the cut is finished. Power supply is protected by an auxiliary plant. A rough and a finish cut are made on each of the two rows of helical teeth. Pin checks are made during rough machining. Finished





After being forced onto its shaft, a large gear blank has its outside diameter rough turned on this 20-ft. boring mill



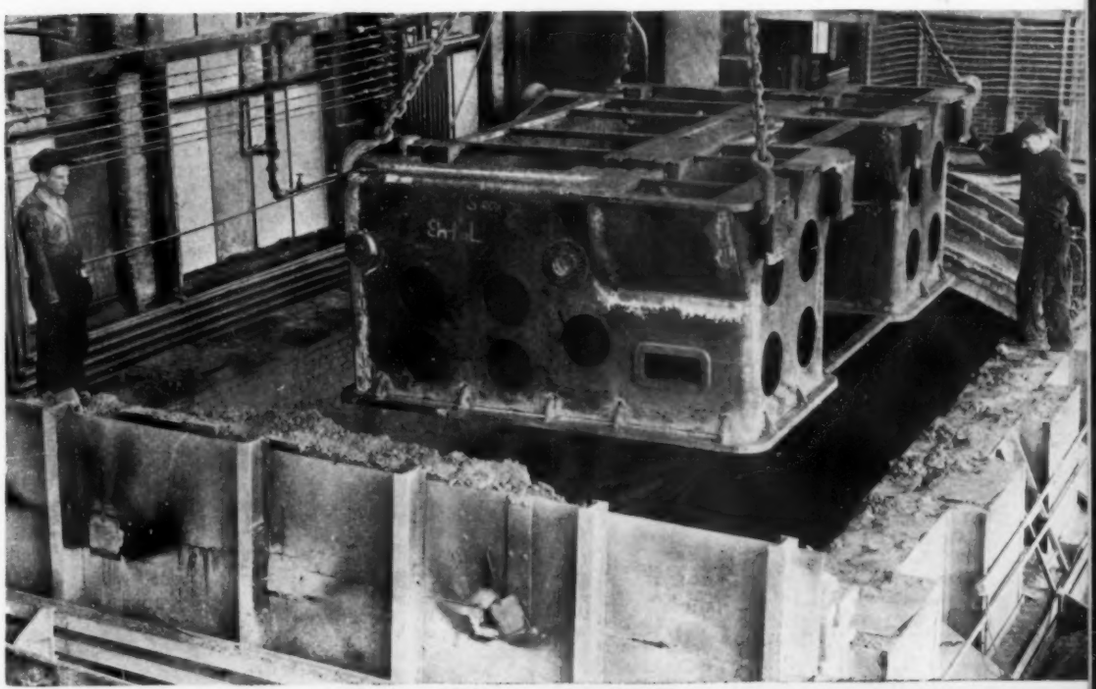
About 85 hr. are required to hob the teeth in this 163-in. bull gear. Here teeth are being checked between roughing and finishing cuts

tooth spacing tolerance is 0.0003 in.

Nearly as important as the gears themselves are the casings, whose bearing housings must be extremely accurate. These housings are of cast steel, welded into the steel-plate casing. Machining on the bearing housings, done in a horizontal boring mill, is begun after the casing has been annealed and checked.

Operations up to this point require nearly eight months. Assembly and test require almost another two. Testing consists either of driving a generator through the unit or of using two units to drive each other, a motor supplying the losses.

Typical battleship gear reduction installations consist of two medium-speed shafts for each turbine, all four driving a huge bull gear on the propeller shaft



A fabricated gear reduction unit casing is lowered into an annealing furnace for stress removal. Lapped joints are steam-tight without gaskets

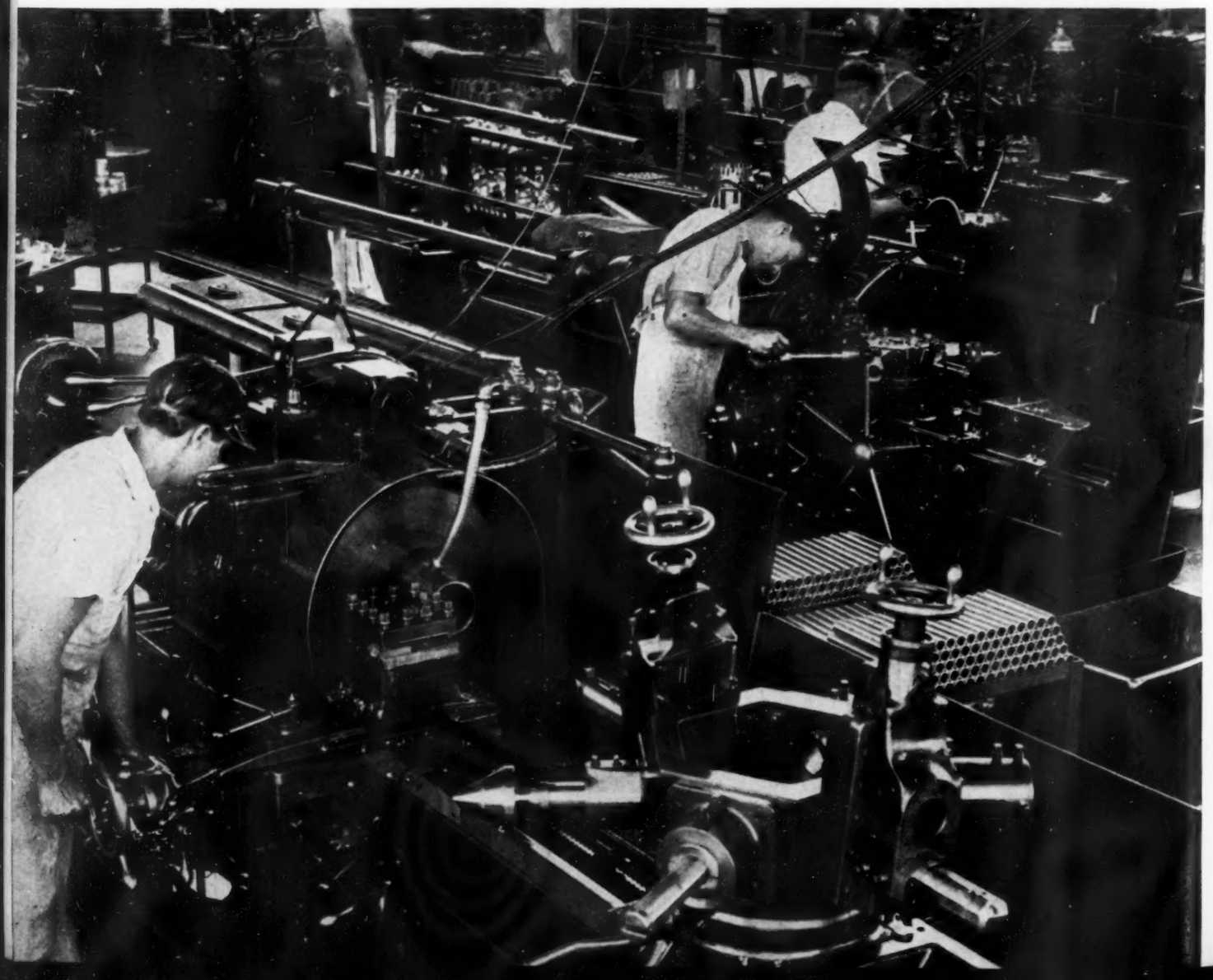
The Problem of AIRCRAFT

Decentralized production of aircraft parts is a vital step in boosting plane output. Here are some of the headaches and one company's cures for them

THOSE OF US who are producing parts for aircraft manufacturers are losing sleep figuring ways to get more work out of the same machines. We are torn between hawk-eyed Army inspectors and aircraft factory production pressure. We are running three full shifts, getting 22½ hours work per day out of each machine. But still we must maintain the highest possible precision.

Our plant was established on the Pacific Coast to manufacture air-hydraulic shock absorbing struts for airplane landing gears. We have steadily expanded operations until now we produce a complete line of hydraulic equipment in addition to the shock struts, most of it to specifications. Our work is highly specialized, and is vital to aircraft makers because in many cases we can make their hydraulic parts faster and more accurately than they can. By turning such work over to us, they free their own equipment for special machine work that is not so adaptable to farming out. They also get the benefit of our experience in this field, which includes

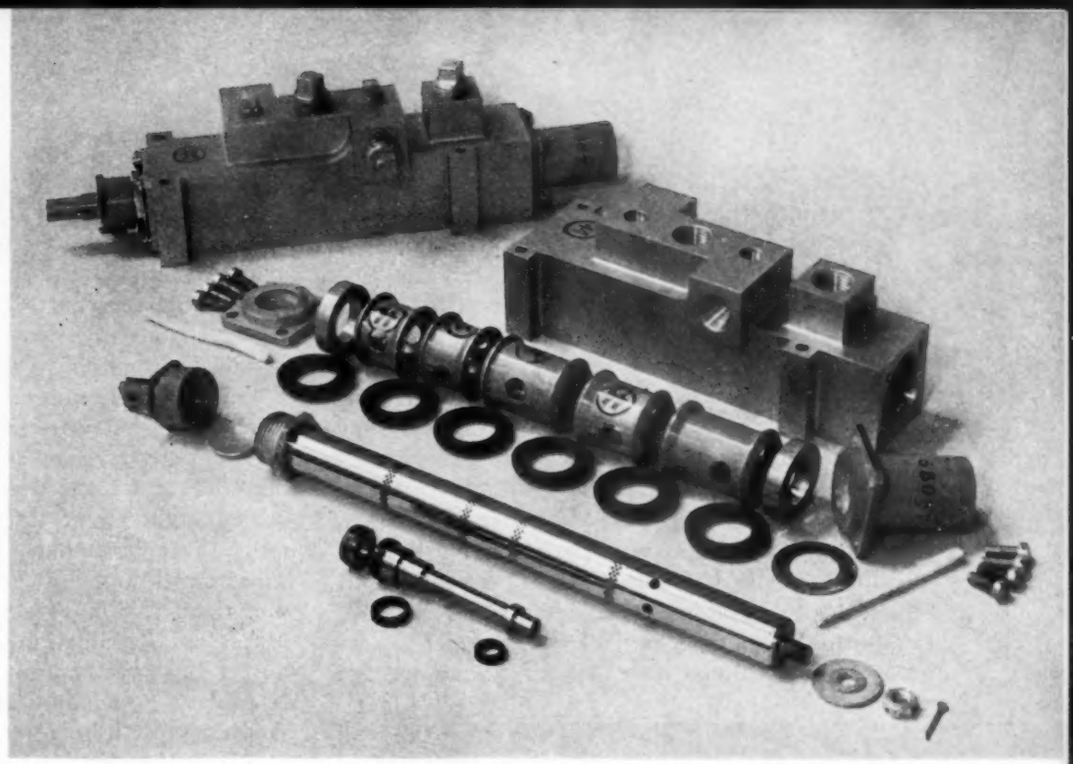
General-purpose machines are used almost exclusively in an aircraft parts shop. Below is a battery of Warner & Swasey turret lathes at work on hydraulic cylinders. Tolerances are the usual aircraft tenths



PARTS

By R. J. WENGER

Shop Superintendent
Bendix Aircraft, Limited



About three dozen separate precision parts make up the special hydraulic valve at the upper left. Cylinder in the foreground has 364 radial holes

producing similar equipment for other aircraft plants.

We used to produce a high percentage of parts in lots varying from 12 to 100. Now most of our orders are for complete units, in lots of 1,000 to 1,200 or more, averaging about 20 parts per unit. We have to inspect, assemble, and test all such units in our own plant and turn them over to the customer ready for installation and operation.

Our backlog is landing-gear shock absorbers and hydraulic actuating cylinders, but other hydraulic equipment which goes through our shop includes hand and motor driven pumps, various types of hydraulic valves, and similar assemblies.

Since hydraulic systems almost invariably involve pistons and cylinders, a large proportion of our machining is circular work, much of it done on turret lathes. About three-fourths of all parts are steel, although many pump and valve bodies are of aluminum or magnesium alloys. These alloys are sometimes finish machined from sand castings or die castings, but frequently are machined from solid stock.

Because we do work for a considerable number of customers our operation is comparable to that of a large job shop. The comparison is not entirely accurate, however, as we must maintain extensive engineering, inspection, final assembly, and test departments. This makes our work a great deal like that of a complete factory. Because we are working on a number of different orders for different customers, our production planning and control department must keep in close touch with all our customers and schedule all work through the shop to meet delivery dates.

To accomplish this our plant in three years has grown from a bare floor and a skeleton crew to a 27,000-sq. ft. plant employing some five hundred people, of whom more than half are in the shop itself. We have gone to a two-shift and then to a three-shift work schedule. Essentially we work three 8-hr. shifts. However, we take out a half-hour lunch period in such a way that the day and evening shifts each work a full 8 hr., while the graveyard shift works but 6½ hr. The actual shifts run: 8 a.m. to 4:30 p.m.; 4:30 p.m. to 1 a.m.; and 1 a.m. to 8 a.m. A maintenance crew is kept on during the day shift only. Because most of the equipment is quite new, this has proved adequate.

Since part of our work comes through our own engineering department, and part from engineering departments of our customers, who furnish us with their own working drawings, we have set up the production planning and control department to cover both types of orders equally. Working from purchase orders or blue prints, production planning breaks down each order into its component parts. Each part is set up on an individual parts chart showing material required, source

of material, estimated machine time, order of operations, tooling requirements, tooling follow-up, etc. A master machine-loading chart helps assign jobs. On this are listed the customer, job, part, description, quantity, hours estimated, when due out, delivery schedule, material, tools, and remarks.

Delivery requirements of the various customers determine the extent of runs. We try to run the maximum number of parts in all set-ups. But we are often forced to break down the operation into a number of periods, rushing through a portion of the work from time to time. In some cases we have to split up the job among various machines and use multiple set-ups. The wall chart, which shows machine loadings over a year ahead, guides

For speed and convenience final assembly and test departments are virtually one. Many hydraulic parts must stand a 4,500-lb. test pressure

our new equipment purchasing far enough in advance to forestall bottlenecks.

In an emergency we may be forced to subcontract some part of a job to another shop. In general, however, we keep ahead of schedule by having one machine of each classification unscheduled. This machine is used for "catch-up" jobs and is never idle. It can be shifted from job to job as delivery needs dictate, and the only loss of efficiency is in more frequent set-ups. A separate delivery requirement chart shows how we stand on any complete order by assemblies. While we are keeping charts to show machine loadings for a year ahead, we are also following through so closely on the heels of all jobs that we check the status of operations every 2 hours throughout the 24. Duplicate-move order cards accompany the job as it progresses from operation to operation. At each change the original stays with the work and the carbon copy is collected and posted in production control to show the new status.

Our shop arrangement is fairly conventional, with batteries of similar machine tools grouped together to simplify work flow. We now have fifteen Warner & Swasey turret lathes, eight engine lathes, five Van Norman mills, three Cincinnati mills, eight drill presses, three multiple spindle drill presses, one hone, one thread mill, two special cylinder boring lathes, a Lees-Bradner thread cutting mill and a Bakewell tapping machine, in addition to toolroom machines and miscellaneous other equipment. Shop operations are monitored by set-up men with each shift, working in the turret lathe, mill, and drill press departments. These men get job cards from production control and follow through from the tool crib to the job set up on the machine. A cross-indexed tool and fixture filing system in the tool crib greatly simplifies tool handling.

Much milling is on light alloy valve bodies, while most lathe work is on steel cylinders and pistons. For one type of four-way hydraulic valve we mill ten alloy valve bodies at a time, arranging all ten on the mill bed with special clamps. Many of our fixture problems, especially on lathe jobs, are particularly difficult because of flexibility of the parts and the high precision required. This is true of hydraulic cylinders, which are machined from chrome-molybdenum steel tubing in a special cylinder boring lathe we designed and built.

With hydraulic units we have many threaded holes for connections. Much of this work is done on a Bakewell hob tapper, which is very fast and extremely accurate. The Lees-Bradner thread cutting mill is also an important tool, as we have certain long shafts of our hydraulic strut assemblies which must be threaded with great precision.

Our final assembly department is unique because of the precision nature of the tests all units must pass following assembly. Assemblymen draw parts that have previously been individually inspected and frequently use special assembly jigs and wrenches. A final inspection crew works right in the assembly department to check and pass completed units. Elaborate test benches are used for final inspection of hydraulic units, test pressures running as high as 4,500 lb. per sq. in.

DEFENSE CONTRACTS

Placed from July 1, 1939, to September 14, 1940, and unfinished to that date

Source of Supply	*Amount*	*Delivery Date*
AIRPLANES	***(WAR)***	
Aviation Mfg. Corp., Wayne, Mich	$1,853,451	Indefinite
Beech Aircraft Corp., Wichita, Kansas	458,764	Indefinite
Bell Aircraft Corp., Buffalo, N. Y	2,833,236	6/31/41
Boeing Aircraft, Seattle, Wash	8,102,892	6/20/41
Consolidated Aircraft Corp., San Diego, Calif	8,613,674	6/20/41
Curtiss-Wright Corp., (Curtiss Aeroplane Div.) Buffalo, N. Y	5,203,481	6/30/41
Douglas Aircraft Co., Inc., El Segundo, Calif	14,470,082	3/ 2/41
Fairchild Engine & Airplane Corp., (Fairchild Aircraft Div.) Hagerstown, Md	1,038,300	3/31/41
	1,586,573	Indefinite
Glenn L. Martin Co., Baltimore, Md	16,125,586	6/30/41
North American Aviation, Inc., Inglewood, Calif	11,847,652	Indefinite
	2,731,617	1/21/41
Seversky Aircraft Corp., Farmingdale, L. I., N. Y	3,547,255	Indefinite
	(NAVY)	
Consolidated Aircraft Corp., San Diego, Calif	$20,016,599	Indefinite
Grumman Aircraft Engineering Corp., Bethpage, L. I., N. Y	1,786,860	11/13/40
Spearman Aircraft, Wichita, Kansas	3,779,628	9/15/41
United Aircraft Corp., East Hartford, Conn	1,998,420	Indefinite
AIRPLANE PARTS	***(WAR)***	
Aviation Mfg. Corp., Williamsport, Pa	$46,800	Indefinite
Beech Aircraft Corp., Wichita, Kansas	3,510,746	6/30/41
Bendix Aviation Corp., South Bend, Ind	56,284	Indefinite
	37,580	2/28/41
	110,200	Indefinite
McCauley Steel Propeller Co., Dayton, Ohio	82,350	Indefinite
Steel Products Engineering Co., Springfield, Ohio	30,690	11/30/40
	(NAVY)	
Bendix Products Div., Bendix Aviation Corp., Bendix, N. J	$120,000	6/30/41
Consolidated Aircraft Corp., San Diego, Calif	21,675	11/ 4/40
	22,286	12/ 6/40
	41,098	11/15/40
Curtiss-Wright Corp., Buffalo, N. Y	41,315	11/12/40
Curtiss-Wright Corp., (Curtiss Propeller Div.) Clifton, N. J	134,822	4/11/42
Douglas Aircraft Co., Inc., Santa Monica, Calif	13,984	Indefinite
	11,564	9/10/41
Grumman Aircraft Eng. Corp., Bethpage, L. I., N. Y	12,715	Indefinite
Hartzell Propeller Co., Piqua, Ohio	20,700	12/30/40
United Aircraft Corp., (Pratt & Whitney Aircraft Div.) East Hartford, Conn	11,944	12 /5/40

Source of Supply	Amount	Delivery Date
United Aircraft Corp., (Hamilton Standard Propeller Div.) East Hartford, Conn	$90,000	6/30/41
	21,075	2/26/41
United Aircraft Corp., (Vought-Sikorsky Aircraft Div.) Stratford, Conn	59,249	11/ 7/40
	14,425	11/14/40
	16,446	12/ 2/40

BRAKE AND WHEEL ASSEMBLIES

(WAR)

Bendix Westinghouse Automotive Air Brake Co., Pittsburgh, Pa.	Indefinite	Indefinite
Hayes Industries, Inc., Jackson, Mich	$23,680	Indefinite
	Indefinite	8/31/41
	121,343	Indefinite
National Acme Co., Cleveland, Ohio	373,126	Indefinite
	74,720	12/26/40

CARTRIDGE CASES *(WAR)*

Albert & J. L. Anderson Mfg. Co., Boston, Mass	$116,040	7/28/41
Bridgeport Brass Co., Bridgeport, Conn	716,800	Indefinite
	554,900	1/13/41
Chase Brass & Copper Co., Inc., Waterbury, Conn	1,353,505	Indefinite
	2,766,813	2/24/42
Chrysler Corp., Detroit, Mich	154,082	2/ 3/41
General Motors Corp., (Guide Lamp Div.) Detroit, Mich	149,362	1/23/41
Norris Stamping Co., Los Angeles, Calif	356,166	2/24/42
Scovill Mfg. Co., Inc., Waterbury, Conn	302,937	1/15/41

(NAVY)

Bridgeport Brass Co., Bridgeport, Conn	$1,187,860	1/10/42
Norris Stamping & Mfg. Co., Los Angeles, Calif	700,309	4/17/42
	253,728	6/12/42
Pollak Mfg. Co., Arlington, N. J	28,500	4/15/41

CARTRIDGE CUPS *(WAR)*

American Brass Co., Torrington, Conn	$20,840	2/20/40
	191,700	Indefinite

CARTRIDGE DISKS *(WAR)*

American Brass Co., Torrington, Conn	$110,950	Indefinite
	646,608	1/ 1/41
American Brass Co., Waterbury, Conn	80,190	Indefinite
Revere Copper & Brass, Inc., Baltimore, Md	1,017,433	1/ 1/41
	114,715	Indefinite

ELECTRICAL MACHINERY *(WAR)*

Federal Telegraph Co., Newark, N. J	*Radio transmitter*	$95,797	7/ 5/41
	Components for radio sets	244,101	1/10/41
General Electric Co., Schenectady, N. Y	*Sighting systems*	355,085	6/ 9/41
General Motors Corp., (Delco Appliance Div.) Rochester, N. Y	*Control equipment*	597,270	Indefinite

Source of Supply	Amount	Delivery Date
General Motors Corp., (Delco Appliance Div.) Rochester, N. Y. — *Control equipment*	$236,534	4/22/41
Hammarlund Mfg. Co. Inc., New York, N. Y. — *Radio receiver*	79,988	3/21/41
International Protector Corp., New York, N. Y. — *Depth-sounding equipment*	142,500	Indefinite
Sperry Gyroscope Co. Inc., Brooklyn, N. Y. — *Sound locators*	1,746,375	1/19/42

ENGINES

(WAR)

Continental Motors Corp., Muskegon, Mich.	$1,066,539	5/ 3/41
	123,879	11/16/40
Eclipse Aviation, Bendix, N. J.	226,259	1/ 8/41
Wright Aeronautical Corp., Paterson, N. J.	839,675	6/ 1/41

(NAVY)

Curtiss-Wright Corp., Buffalo, N. Y.	$15,523	12/23/40
Ranger Aircraft Engines, (Division of Fairchild Engine and Airplane Corp.) Farmingdale, L. I., N. Y.	5,489,308	7/ 1/42
Spartan Aircraft Co., Tulsa, Okla.	1,859,880	Indefinite
United Aircraft Corp., (Pratt & Whitney Aircraft Div.) East Hartford, Conn.	7,952,766	Indefinite
	28,959	Indefinite
Wright Aeronautical Corp., Paterson, N. J.	19,183	Indefinite
	10,181	Indefinite
	375,009	12/ 1/40
	400,000	6/30/41

FORGINGS

(WAR)

Aluminum Co. of America, Edgewater, N. J.	$14,751	Indefinite
American Forge Div., American Brake Shoe & Foundry Co., Chicago, Ill.	624,000	2/19/41
	70,235	12/29/40
	160,500	Indefinite
American Locomotive Co., Schenectady, N. Y.	118,800	Indefinite
Baldwin Locomotive Works., Eddystone, Pa.	240,272	4/11/41
Bethlehem Steel Co., Bethlehem, Pa.	29,952	Indefinite
	121,728	Indefinite
	121,728	Indefinite
Chase Brass & Copper Co., Inc., Waterbury, Conn.	31,600	Indefinite
General Motors Corp., (Chevrolet Motor Div.) Detroit, Mich.	36,127	12/ 5/40
Chrysler Corp., Detroit, Mich.	67,320	12/30/40
Colorado Fuel & Iron Corp., Denver, Colo.	251,675	3/ 1/41
Crucible Steel Co. of America, New York, N. Y.	177,098	5/ 7/41
Crucible Steel Co. of America, Harrison, N. J.	47,125	Indefinite
	40,587	1/10/41
A. Finkl & Sons Co., Chicago, Ill.	65,000	6/ 5/41
Harvey Metal Corp., Chicago, Ill.	14,175	Indefinite
	23,855	Indefinite
	90,930	Indefinite
Kilby Steel Co., Anniston, Ala.	113,228	2/10/41
Midvale Co., Philadelphia, Pa.	110,897	11/ 9/40
	101,080	Indefinite
Mueller Brass Co., Port Huron, Mich.	107,550	Indefinite
	22,000	Indefinite
National Forge & Ordnance Co., Irvine, Pa.	65,500	6/28/41
	39,685	4/ 1/41
National Tube Co., McKeesport, Pa.	134,384	12/16/40
	52,276	Indefinite

Source of Supply	Amount	Delivery Date
Peco Mfg. Corp., Philadelphia, Pa	$75,000	Indefinite
	295,000	Indefinite
Pennsylvania Forge Corp., Philadelphia, Pa	44,767	3/ 1/41
	107,060	12/23/40
	76,250	Indefinite
Pressed Steel Car Co. Inc., McKees Rocks, Pa	119,832	12/15/40
Pullman-Standard Car Mfg. Co., Butler, Pa	81,590	1/15/41
Scovill Mfg. Co., Waterbury, Conn	47,575	Indefinite
Struthers-Wells-Titusville Corp., Titusville, Pa	199,500	Indefinite
	207,575	Indefinite
	64,500	3/15/41
	65,783	3/14/41
	36,078	2/17/41
Taylor-Wharton Iron & Steel Co., Easton, Pa	129,770	11/ 2/40
Tennessee Coal Iron & RR. Co., Birmingham, Ala	123,739	3/ 8/41
(NAVY)		
Allis-Chalmers Mfg. Co., Milwaukee, Wis	$82,720	11/10/40
Aluminum Co. of America, Cleveland, Ohio	20,690	1/ 1/41
	35,967	1/ 1/41
Bethlehem Steel Co., Bethlehem, Pa	378,425	Indefinite
	210,000	1/23/41
	1,066,738	1/31/42
	97,162	8/ 1/41
	75,254	Indefinite
	180,120	Indefinite
	609,000	Indefinite
Camden Forge Co., Camden, N. J	134,877	11/ 1/41
Carnegie-Illinois Steel Corp., Munhall, Pa	213,775	2/20/41
Crucible Steel Co. of America, Harrison, N. J	468,458	8/31/41
	208,536	8/ 1/41
	882,300	1/ 1/42
	22,100	12/10/40
Erie Forge Co., Erie, Pa	60,721	6/ 1/41
	534,574	2/ 1/42
Heppenstall Co., Pittsburgh, Pa	166,344	3/ 1/41
International Nickel Co., Inc., Huntington, W. Va	13,108	12/26/40
	92,208	Indefinite
	45,200	Indefinite
Ladish Drop Forge Co., Cudahy, Wis	15,912	Indefinite
Midvale Co., Philadelphia, Pa	12,998	12/ 1/40
	2,282,820	2/25/42
	1,879,536	Indefinite
	22,900	3/ 9/41
	134,640	11/ 9/40
National Forge & Ordnance Co., Irvin, Pa	62,250	Indefinite
	504,309	11/30/41
	17,479	3/ 1/41
Pennsylvania Forge Corp., Philadelphia, Pa	103,217	2/20/41
	40,118	2/28/41
	88,730	2/26/41
Struthers-Wells-Titusville Corp., Titusville, Pa	87,520	1/26/41
	82,700	11/10/40

GUNS AND PARTS *(WAR)*

Bay Tool and Machine Co., Springfield, Mass	$34,136	3/ 5/41
C. H. Cowdrey Machine Works, Fitchburg, Mass	174,208	9/20/41
Charles Fischer Spring Co., Brooklyn, N. Y	17,128	12/20/40

Source of Supply	Amount	Delivery Date
General Electric Co., Schenectady, N. Y.	$201,090	5/31/41
	552,834	11/30/41
Hadley Special Tool Co., Inc., Boston, Mass.	81,054	1/ 9/41
Harrington & Richardson Arms Co., Worcester, Mass.	193,497	8/ 9/41
Midvale Co., Philadelphia, Pa.	428,736	Indefinite
National Pneumatic Co. Inc., Rahway, N. J.	1,412,227	11/15/41
Saginaw Steering Div., General Motors Corp., Saginaw, Mich.	726,004	6/15/41
Singer Mfg. Co., Elizabeth, N. J.	278,875	1/13/42
United Shoe Machinery Corp., Boston, Mass.	1,316,485	2/10/42
York Safe & Lock Co., York, Pa.	719,198	Indefinite

IRON, STEEL, BRASS, ETC. PRODUCTS

(WAR)

American Brass Co., Kenosha, Wis.	*Metal tubing*	$32,966	Indefinite
American Brass Co., Waterbury, Conn.	*Copper rotating bands*	21,059	Indefinite
American Bridge Co., Ambridge, Pa.	*Gun emplacements*	11,592	11/30/40
American Car & Foundry Co., Berwick, Pa.	*Pontoon bridge equipment*	247,390	Indefinite
	Parts	29,580	11/10/40
Atlas Powder Co., Wilmington, Del.	*Starter cartridges*	20,400	Indefinite
Baldwin Locomotive Works, Philadelphia, Pa.	*Gun mounts*	1,114,454	11/10/40
Bethlehem Steel Co., Bethlehem, Pa.	*Demolition bombs*	2,545,095	6/30/41
Bridgeport Thermostat Co. Inc., Bridgeport, Conn.	*Practice bomb*	188,167	5/26/41
Builders Iron Foundry, Providence, R. I.	*Telescope mounts*	105,509	6/16/41
Burgess-Norton Mfg. Co., Geneva, N. Y.	*Bodies*	37,632	12/16/40
Chrysler Corp., Detroit, Mich.	*Bomb fuses*	97,079	1/26/41
Consolidated Steel Corp., Ltd., Los Angeles, Calif.	*Demolition bombs*	109,626	1/29/41
Corbin Screw Corp., New Britain, Conn.	*Bomb fuses*	29,340	2/28/41
Crucible Steel Co. of America, New York, N. Y.	*Shot*	113,236	7/ 5/41
Diebold Safe & Lock Co., Canton, Ohio.	*Parts*	27,580	1/ 1/41
Henry Disston & Sons, Inc., Philadelphia, Pa.	*Armor plate*	1,424,089	4/ 3/41
		68,006	7/ 1/41
Doehler Die Casting Co., Pottstown, Pa.	*Die castings*	50,087	1/ 7/41
Enterprise Tool & Gear Corp., Detroit, Mich.	*Gears*	52,012	2/28/41
A. B. Farquhar Co., Ltd., York, Pa.	*Mortars & Mounts*	128,459	Indefinite
Federal Screw Works, Chelsea, Mich.	*Fuse units*	32,622	4/17/41
	Components for booster	59,795	12/30/40
Charles Fischer Spring Co., Brooklyn, N. Y.	*Parts for rifles*	17,128	12/20/40
Fort Pitt Bedding Co., Pittsburgh, Pa.	*Metallic belt links*	419,200	12/31/41
Fulton Sylphon Co., Knoxville, Tenn.	*Fuses*	101,991	7/26/41
General Motors Corp., Cleveland, Ohio.	*Propelling machinery*	2,317,857	Indefinite
Grayson Heat Control Ltd., Lynwood, Calif.	*Bomb fuses*	98,092	5/19/41
H. Grinton Co., Philadelphia, Pa.	*Telescope mounts*	17,961	12/ 7/40
James Cunningham Son & Co., Rochester, N.Y.	*Carriage assemblies*	62,856	12/22/40
Karp Metal Products Co., Inc., Brooklyn, N. Y.	*Radio cabinet assemblies*	20,461	2/26/41
Lukenweld, Inc., Coatesville, Pa.	*Base rings*	39,504	2/10/41
Lundquist Tool & Mfg. Co., Worcester, Mass.	*Telescope mounts*	105,710	2/25/41
		39,240	11/ 3/41
Martin-Parry Corp., York, Pa.	*Fin assemblies*	10,232	Indefinite
Mattatuck Mfg. Co., Waterbury, Conn.	*Battery cups*	12,380	Indefinite
Mergenthaler Linotype Co., Brooklyn, N. Y.	*Telescope mounts*	545,591	1/14/42
	Aiming circles	128,953	10/26/41

Source of Supply		Amount	Delivery Date
National Pneumatic Co., Rahway, N. J.	*Mortars and mounts*	$10,312	6/ 1/41
Oliver Iron & Steel Corp., Pittsburgh, Pa.	*Lifting plugs*	16,727	12/31/40
Parker Appliance Co., Cleveland, Ohio	*Adapters*	10,987	Indefinite
Peco Mfg. Corp., Philadelphia, Pa.	*Nose plugs*	23,287	Indefinite
Philco Corp., Philadelphia, Pa.	*Fuses*	133,485	8/29/41
Remington Arms Co., Inc., Bridgeport, Conn.	*Ammunition*	655,774	12/31/40
Remington Arms Co. Inc., Bridgeport, Conn.	*Percussion assemblies*	55,000	3/ 1/41
Revere Copper & Brass, Inc., Rome, N. Y.	*Battery cups*	15,750	Indefinite
Revere Copper & Brass, Inc., Baltimore, Md.	*Hard bands*	20,290	Indefinite
Russakov Can Co., Chicago, Ill.	*Practice bombs*	117,300	1/26/41
Scovill Mfg. Co., Waterbury, Conn.	*Primer bodies*	232,500	Indefinite
	Primer bodies	43,500	Indefinite
Seth Thomas Clocks, Thomaston, Conn.	*Fuse parts*	36,825	Indefinite
Standard Pressed Steel Co., Jenkintown, Pa.	*Heads for primer*	65,730	Indefinite
	Bullet cores	304,800	6/22/41
	Components for primers	42,251	Indefinite
Standard Steel Works, North Kansas City, Mo.	*Box assemblies*	19,468	Indefinite
Struthers-Wells-Titusville Corp., Titusville, Pa.	*Breech rings*	23,166	12 /5/40
Thompson Products, Inc., Detroit, Mich.	*Fuse adapters*	121,282	Indefinite
Tophams, Inc., Washington, D. C.	*Pontoon bridge equipment*	41,128	Indefinite
Treadgear Co., Richmond, Va.	*Practice projectiles*	99,855	Indefinite
Variety Aircraft Corp., Dayton, Ohio	*Stand assemblies*	177,500	10/28/41
Vega Airplane Co., Burbank, Calif.	*Trainer assemblies*	63,550	1/24/41
Waltham Watch Co., Waltham, Mass.	*Fuse parts*	16,619	Indefinite
Westclox, Div. of General Time Instruments Corp., La Salle, Ill.	*Fuse parts*	185,299	3/13/41
	Fuse parts	46,365	Indefinite
Western Cartridge Co., East Alton, Ill.	*Cartridge*	454,798	5/ 1/42
Wright Machine Co., Worcester, Mass.	*Body plugs*	10,399	Indefinite
York Safe & Lock Co., York, Pa.	*Fuse setters*	122,132	7/14/41
	Gun carriages	794,300	5/ 1/41
		829,500	5/30/41
	Cradle assemblies	57,050	11/ 2/40
(NAVY)			
William R. Bootz, Evansville, Ind.	*Practice bombs*	$14,012	4/ 2/41
Camden Forge Co., Camden, N. J.	*Training circle racks*	137,500	6/ 1/41
Carnegie-Illinois Steel Corp., Pittsburg, Pa.	*Steel plates*	496,620	Indefinite
Carnegie-Illinois Steel Corp., Munhall, Pa.	*Steel plates*	4,702,240	5/31/41
Doehler Die Castings Co., Pottstown, Pa.	*Miniature bombs*	15,100	12/ 7/40
	Practice bombs	19,140	12/27/40
Dravo Corp., Pittsburgh, Pa.	*Caisson*	574,800	Indefinite
Edwards Mfg. Co., Cincinnati, Ohio	*Practice bombs*	79,166	3/ 9/41
	Practice bombs	53,100	1/13/41
Fairbanks Morse & Co., Beloit, Wis.	*Propelling machinery*	1,435,360	Indefinite
General Motors Corp., (Cleveland Diesel Engine Div.) Cleveland, Ohio	*Propelling machinery*	1,358,159	Indefinite
Howard Foundry Co., Chicago, Ill.	*Protecting cap assemblies*	92,097	4/15/42
Lukenweld Inc., Coatesville, Pa.	*Carriage slides*	60,948	Indefinite
McKiernan-Terry Corp., Harrison, N. J.	*Winches*	16,448	11/27/40
Midvale Co., Philadelphia, Pa.	*Slides*	320,200	Indefinite
Mitchell Metal Products, Inc., Cleveland, Ohio	*Extractors for cartridge cases*	28,350	4/15/42
National Forge & Ordnance Co., Irvine, Pa.	*Propeller shafts*	70,275	11/ 6/40
Norris Stamping & Mfg. Co., Los Angeles, Calif.	*Ammunition boxes*	335,524	10/ 1/42
Pollak Mfg. Co., Arlington, N. J.	*Ammunition boxes*	16,500	Indefinite
	Aluminum containers	28,500	4/15/41

Source of Supply		Amount	Delivery Date
Pressed Steel Tank Co., West Allis, Wis	*Afterbody shells*	$24,876	Indefinite
Remington Arms Co., Inc., Bridgeport, Conn	*Cartridges*	44,120	Indefinite
Russakov Die Castings Co., Chicago, Ill	*Practice bombs*	71,400	2/20/41
Shenango-Penn Mold Co., Dover, Ohio	*Propeller sleeves*	15,372	11/21/40
Stewart Warner Corp., Chicago, Ill	*Steel bodies*	33,930	Indefinite
Struthers-Wells-Titusville Corp., Titusville, Pa	*Crankshafts*	16,950	11/16/40
Treadwell Engineering Co., Easton Pa	*Gun saddles*	36,850	Indefinite
Widan Metal Goods Co., Garwood, N. J	*Machine gun mounts*	59,197	12 /9/40
York Safe & Lock Co., York, Pa	*Gun mounts*	59,846	Indefinite

NAVAL VESSELS *(NAVY)*

Bath Iron Works Corp., Bath, Maine	*Destroyer*	$4,898,000	12/12/41
		4,813,000	6/15/41
		4,813,000	8/15/41
		4,898,000	2/12/42
Bethlehem Steel Co., Quincy, Mass	*Light cruiser*	11,695,000	7/25/42
		11,695,000	9/25/42
	Aircraft carrier	Indefinite	12/ 2/40
Electric Boat Co., Groton, Conn	*Submarine*	2,957,000	2/12/42
		2,957,000	2/27/42
		2,957,000	5/12/42
		2,937,000	7/15/41
		2,937,000	9/15/41
		2,937,000	11/15/41
		2,797,000	5/15/41
Federal Shipbuilding & Dry Dock Co., Kearny, N. J.	*Destroyer*	4,895,000	6/15/41
		4,895,000	8/15/41
		5,277,000	12/12/41
		5,277,000	2/12/42
	Light cruiser	12,226,000	4/25/42
	Light cruiser	12,226,000	6/25/42
Higgins Industries, Inc., New Orleans, La	*Boats*	856,406	12/30/40
	Surf boats	57,896	12/31/40
Robert Jacob, Inc., City Island, N. Y	*Harbor tugs*	417,690	1/30/41
Livingston Shipbuilding Co., Orange, Texas	*Surf landing boats*	118,824	11/20/40
Luders Marine Constr. Co., Stamford, Conn	*Harbor tugs*	397,000	7/ 1/41
Newport News Shipbuilding & Drydock Co., Newport News, Va	*Aircraft carrier*	21,800,000	2/10/42
New York Shipbuilding Corp., Camden, N. J	*Light cruiser*	17,990,000	3/23/43
		17,990,000	6/23/43
	Cruisers	17,580,000	6/27/43
		17,580,000	9/27/43
	Repair ship	13,997,000	4/ 1/42

ON-CARRIAGE PARTS *(WAR)*

Eclipse Aviation Div., Bendix Aviation Corp., Bendix, N. J		$267,491	Indefinite
		14,860	Indefinite
		19,500	7/20/41
		43,331	11/ 6/41

PUMP ASSEMBLIES *(WAR)*

Pump Engineering Service Corp., Cleveland, Ohio		$23,400	Indefinite
		26,605	Indefinite
		36,066	12/23/40

Source of Supply	Amount	Delivery Date
SHELLS (WAR)		
American Cork Co., Lancaster, Pa	$81,311	4/26/41
Babcock Printing Press Corp., New London, Conn	183,131	3/27/41
J. C. Beaird Corp., Shreveport, La	108,919	6/19/41
Bethlehem Steel Co., Bethlehem, Pa	26,344	12/14/40
Budd Wheel Co., Detroit, Mich	589,446	4/30/41
	193,257	1/13/41
	375,996	1/15/41
	259,266	3/17/41
	447,037	2/10/41
	206,558	1/ 6/41
	1,737,000	4/28/41
	1,198,393	2/ 8/42
Chevrolet Motor Div., General Motors Corp., Detroit, Mich.	100,850	6/ 8/41
Chrysler Corp., Detroit, Mich	110,616	3/ 9/41
Continental Gin Co., Birmingham, Ala	72,521	5/12/41
Darling Valve & Mfg. Co., Williamsport, Pa	58,902	3/17/41
General Iron Works Co., Denver, Colo	115,455	9/ 1/41
General Railway Signal Co., Rochester, N. Y	112,560	1/ 6/41
Key Co., East St. Louis, Ill	164,205	3/ 1/41
Kingston Products Corp., Kokomo, Ind	45,062	12/18/40
Line Material Co., Milwaukee, Wis	104,432	8/ 3/41
Minneapolis-Moline Power Implement Co., Minneapolis, Minn.	141,142	6/21/41
Motor Wheel Corp., Lansing, Mich	67,108	1/ 2/41
Murray Co., Atlanta, Ga	91,206	11/13/41
New York Air Brake Co., Watertown, N. Y	79,552	3/ 3/41
W. C. Norris Mfg. Co., Inc., Tulsa, Okla	76,689	10/10/41
Omaha Steel Works, Omaha, Neb	161,658	11/30/41
Pullman Standard Car Mfg. Co., Butler, Pa	171,997	3/ 5/41
Stockham Pipe Fittings Co., Birmingham, Ala	69,937	5/ 8/41
U. S. Machine Corp., Lebanon, Ind	35,155	12/ 3/40
Henry Vogt Machine Co., Louisville, Ky	185,165	8/ 4/41
Wheland Co., Chattanooga, Tenn	66,758	1/ 9/41
TRACTOR-TRUCKS (WAR)		
Allis Chalmers Mfg. Co., Milwaukee, Wis	$512,346	4/17/41
	684,063	12/20/41
Auto Sales & Service Co., Ardmore, Pa	393,652	4/ 8/41
Biederman Motors Corp., Cincinnati, Ohio	124,582	11/29/40
Caterpillar Tractor Co., Peoria, Ill	137,456	11/22/40
International Harvester Co., Chicago, Ill	2,272,500	4/17/41
TRUCKS (WAR)		
American Bantam Car Co., Butler, Pa	$173,070	Indefinite
Corbitt Co., Henderson, N. C	1,396,664	1/ 4/41
	101,526	Indefinite
Diamond T Motor Car Co., Chicago, Ill	3,249,414	12/28/40
Fargo Motor Corp., Detroit, Mich	11,650,985	1/25/41
	929,265	12/26/40
General Motors Corp., (Chevrolet Div.) Detroit, Mich	549,213	Indefinite
Heil Co., Milwaukee, Wis	117,515	Indefinite

Source of Supply	Amount	Delivery Date
MARMON-HERRINGTON CO. INC., Indianapolis, Ind	$27,060	11/10/40
PRESSED STEEL CAR CO. INC., Pittsburgh, Pa	16,344	12/26/40
YELLOW TRUCK & COACH MFG. CO., (General Motors Truck & Coach Div.) Pontiac, Mich	2,510,357	1/20/41
	12,917,671	12/31/40
	402,790	Indefinite
(NAVY)		
INTERNATIONAL HARVESTER CO., INC., Fort Wayne, Ind	$33,460	11/30/40
MARMON-HERRINGTON CO., INC., Indianapolis, Ind	75,400	12/23/40
	90,464	12/13/40

OTHER TRANSPORTATION EQUIPMENT

(WAR)			
AMERICAN CAR & FOUNDRY CO., New York, N. Y.	*Light tanks*	$6,055,251	1/13/41
		11,496,951	4/17/41
BALDWIN LOCOMOTIVE WORKS, Eddystone, Pa.	*Wheel & axle assemblies*	13,140	Indefinite
BARNARD AVIATION EQUIP. CO. INC., Wilkes-Barre, Pa.	*Cannon mount assemblies*	17,582	2/20/41
BENDIX AVIATION CORP., (Eclipse Aviation Div.) Bendix, N. J.	*Starter assemblies*	191,836	Indefinite
	Parts for generators and starters	25,148	Indefinite
	Starters	14,220	Indefinite
EDWARD G. BUDD MFG. CO., Philadelphia, Pa.	*Wing panels*	43,204	Indefinite
CENTURY BOAT CO. OF MANISTEE, Manistee, Mich.	*Boats*	114,359	Indefinite
DOUGLAS AIRCRAFT CO., INC., Santa Monica, Calif.	*Gun sight assemblies*	115,000	Indefinite
FEDERAL MOTOR TRUCK CO., Detroit, Mich.	*Truck parts*	Indefinite	Indefinite
HEIL CO., Milwaukee, Wis.	*Trailers*	832,330	Indefinite
INDIAN MOTOR CYCLE CO., Springfield, Mass.	*Parts for motorcycles*	Indefinite	Indefinite
LINK AVIATION DEVICES, INC., Binghamton, N.Y.	*Trainer assemblies*	509,182	Indefinite
MACK MFG. CORP., Allentown, Pa.	*Transportation auxiliaries*	82,860	Indefinite
STANDARD STEEL WORKS, North Kansas City, Mo.	*Adapters*	18,750	1/15/41
STEEL PRODUCTS ENGR. CO., Springfield, Ohio	*Engine adapter cyclinders*	19,750	Indefinite
TRAILER CO. OF AMERICA, Cincinnati, Ohio	*Trailers*	40,780	Indefinite
WHITE MOTOR CO., Cleveland, Ohio	*Scout cars*	5,412,936	6/23/41
(NAVY)			
BENDIX PRODUCTS DIV., BENDIX AVIATION CORP., South Bend Ind.	*Wheels and axles*	$55,629	Indefinite
	Landing gears	17,757	Indefinite
	Carburetor assemblies	25,537	Indefinite
J. EDWARD BOLICH, Philadelphia, Pa.	*Brakes*	12,070	11/23/40
H. ADDISON BOWIE, Washington, D. C.	*Motorcycle parts*	34,096	2/ 5/41
CHARLES BRUNING CO. INC., Pasadena, Calif.	*Aircraft protractors*	11,850	Indefinite
DORSEY BROS., Elba, Fla.	*Trailers*	14,510	12/ 9/40
ECLIPSE AIRCRAFT DIV., Bendix, N. J.	*Starters*	43,614	Indefinite
GENERAL MOTORS CORP., Cleveland, Ohio.	*Propelling machinery*	2,056,250	Indefinite
PIONEER INSTRUMENT CO. INC., Bendix, N. J.	*Altimeter parts*	103,635	Indefinite
PUMP ENGINEERING SERV. CORP., Cleveland, Ohio.	*Pumps*	11,339	Indefinite
STEEL PRODUCTS ENGR. CO., Springfield, Ohio.	*Propeller hubs*	16,330	Indefinite
UNITED AIRCRAFT CORP., (Pratt & Whitney Aircraft Div.) East Hartford, Conn.	*Aircraft magnetoes*	24,725	11/26/40
WRIGHT AERONAUTICAL CORP., Paterson, N. J.	*Crankshaft assemblies*	36,514	Indefinite

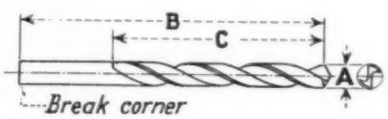
MISCELLANEOUS EQUIPMENT

Source of Supply		Amount	Delivery Date
(WAR)			
Bausch & Lomb Optical Co., Rochester, N. Y.	*Telescopic sights*	$109,322	5/19/41
	Octants	112,350	5/21/41
	Spotting instruments	45,926	1/24/42
Bendix Aviation Corp., Pioneer Instrument Div., Bendix, N. J.	*Driftmeter assemblies*	50,000	8/ 2/41
Cambridge Instrument Co., Inc., New York	*Indicator assemblies*	11,375	Indefinite
Cummings Machine Works, Boston, Mass.	*Range quadrant*	51,587	5/ 6/41
Eastman Kodak Co., Rochester, N. Y.	*Aiming circles*	104,411	4/ 6/41
Fairchild Aviation Corp., Jamaica, N. Y.	*Aircraft cameras*	468,757	7/28/41
	Aircraft cameras	10,626	Indefinite
	Aircraft cameras	509,941	2/20/41
General Electric Co., Schenectady, N. Y.	*Sighting systems*	51,794	7/ 2/41
W. & L. E. Gurley, Troy, N. Y.	*Azimuth instruments*	255,312	Indefinite
Keuffel & Esser Co., Hoboken, N. J.	*Height finders*	887,716	12/31/42
	Height finders	718,727	Indefinite
	Height finders	542,082	1/ 1/42
Kollsman Instrument Co., Inc., Elmhurst, N. Y.			
	Air speed indicator assemblies	32,830	Indefinite
	Indicators	39,771	Indefinite
	Altimeter assemblies	83,350	Indefinite
W. L. Maxon Corp., New York, N. Y.	*Quadrants*	105,589	10/25/41
Mergenthaler Linotype Co., Brooklyn, N. Y.	*Telescopes*	99,557	7/16/41
	Range quadrants	797,664	1/14/42
Minneapolis-Honeywell Regulator Co., Minneapolis	*Sights*	45,309	6/ 1/41
Pioneer Instrument Co. Inc., Bendix, N. J.	*Indicator assemblies*	114,400	Indefinite
	Driftmeter assemblies	573,990	6/20/41
Precision Mfg. Co., Philadelphia, Pa.	*Telescope mounts*	68,120	3/31/41
Safety Car Heating & Lighting Co., New York, N. Y.			
	Sighting equipment	129,938	6/ 2/41
Spencer Lens Co., Buffalo, N. Y.	*Projector and accessories*	31,299	Indefinite
	Azimuth instrument	43,838	2/24/41
Sperry Gyroscope Co., Inc., Brooklyn, N. Y.	*Sound locators*	2,154,260	1/31/42
	Gyroscope test apparatus	14,400	1/20/41
	Parts for Searchlight	18,279	1/14/41
	Theodolite	17,400	Indefinite
Tuthill Pump Co., Chicago, Ill.	*Quadrants*	41,513	12/16/40
Variety Aircraft Corp., Dayton, Ohio	*Telorus assemblies*	15,566	1/18/41
David White Co., Milwaukee, Wis.	*Theodolite*	39,650	1/ 9/41
(NAVY)			
Keuffel & Esser Co., Hoboken, N. J.	*Theodolites*	$14,960	5/28/41
Kollsman Instrument Co. Inc., Elmhurst, N. Y.	*Aircraft compasses*	12,831	Indefinite
	Aircraft altimeters	96,152	Indefinite
	Air speed indicators	19,950	Indefinite
	Tachometer generators	38,972	1/13/41
Bendix Aviation Corp., Bendix, Pioneer Instrument Div., N. J.	*Aircraft accelerometers*	Indefinite	Indefinite
	Aircraft octants	227,075	Indefinite
	Turn and tank indicators	41,580	Indefinite
	Aircraft indicators	29,767	Indefinite
	Generators	46,900	12/28/40
Spencer Lens Co., Buffalo, N. Y.	*Telescopic alidades*	40,596	7/22/41
Spencer Lens Optical Co., Rochester, N. Y.	*Telescopic alidades*	58,220	Indefinite
Sperry Gyroscope Co. Inc., Brooklyn, N. Y.	*Gyros*	201,600	Indefinite
	Gyros	216,000	Indefinite
	Automatic pilot	950,136	Indefinite

Straight-Shank Drill Standards

AMERICAN STANDARDS ASSOCIATION has approved standards for straight-shank twist drills. It is intended to establish (1) American standard practice for terminology and definitions of such drills, (2) the preferred diameters of straight-shank drills varying in diameter from 0.0156 to 0.500 in., and (3) the corresponding drill length and flute lengths. The standard was sponsored by the A.S.M.E., S.A.E., and the National Machine Tool Builders Association.

The standard covers a sufficient number of drill diameters to provide suitable percentages of screw thread depth in tapped holes for different conditions pertaining to each thread size in the American Standard Course and the American Standard Fine Screw Thread Series within the range of the drills specified.



Dimensions for 0.0156–0.2460-in. diameter drills

Diameter of Drill A	Over-All Length B	Flute Length C
0.0156	7/8	3/16
0.0180	15/16	3/16
0.0200	1	1/4
0.0225	1 1/8	1/4
0.0240	1 3/16	5/16
0.0260	1 5/16	7/16
0.0280	1 5/16	7/16
0.0295	1 3/8	7/16
0.0312	1 1/2	9/16
0.0330	1 1/2	5/8
0.0350	1 1/2	5/8
0.0370	1 1/2	5/8
0.0390	1 1/2	5/8
0.0410	1 9/16	11/16
0.0430	1 11/16	3/4
0.0453	1 11/16	3/4
0.0469	1 3/4	3/4
0.0492	1 11/16	3/4
0.0512	1 3/4	3/4
0.0531	1 3/4	7/8
0.0550	1 13/16	7/8
0.0571	1 13/16	7/8
0.0591	1 13/16	7/8
0.0610	1 13/16	7/8
0.0625	2 1/2	1 1/4
0.0630	1 7/8	7/8
0.0650	1 7/8	15/16
0.0670	1 15/16	15/16
0.0700	1 15/16	15/16
0.0730	2	15/16
0.0760	2 1/16	1 1/16
0.0781	2 5/8	1 3/8
0.0810	2 1/8	1 1/8
0.0827	2 3/16	1 3/16
0.0860	2 3/16	1 1/8
0.0890	2 1/4	1 1/8
0.0906	2 1/4	1 1/4
0.0937	2 3/4	1 1/2
0.0960	2 5/16	1 1/4
0.0995	2 7/16	1 3/8
0.1024	2 7/16	1 7/16
0.1040	2 1/2	1 3/8
0.1065	2 9/16	1 1/2
0.1094	2 7/8	1 5/8
0.1130	2 11/16	1 5/8
0.1160	2 11/16	1 5/8
0.1200	2 3/4	1 5/8
0.1220	2 3/4	1 5/8

Diameter of Drill A	Regular Series		Long Series	
	Over-All Length B	Flute Length C	Over-All Length B	Flute Length C
0.1250	3	1 3/4	5 1/8	3
0.1285	2 13/16	1 3/4	....	....
0.1299	2 13/16	1 11/16	....	....
0.1339	2 13/16	1 11/16	....	....
0.1360	2 13/16	1 3/4	....	....
0.1378	2 13/16	1 11/16	....	....
0.1406	3 1/8	1 7/8	5 3/8	3 1/4
0.1440	2 15/16	1 7/8	....	....
0.1470	2 15/16	1 7/8	....	....
0.1520	3 1/16	1 7/8	....	....
0.1562	3 1/4	2	5 3/8	3 1/4
0.1610	3 3/16	2	....	....
0.1660	3 1/4	2	....	....
0.1695	3 5/16	2 1/8	....	....
0.1719	3 3/8	2 1/8	5 3/4	3 1/2
0.1730	3 5/16	2 1/8	....	....
0.1770	3 3/8	2 1/8	....	....
0.1800	3 7/16	2 1/4	....	....
0.1850	3 1/2	2 1/4	....	....
0.1875	3 1/2	2 1/4	5 3/4	3 1/2
0.1910	3 9/16	2 1/4	....	....
0.1935	3 5/8	2 3/8	....	....
0.1960	3 11/16	2 3/8	....	....
0.1990	3 11/16	2 3/8	....	....
0.2031	3 5/8	2 3/8	6	3 5/8
0.2090	3 7/8	2 1/2	....	....
0.2130	3 15/16	2 5/8	....	....
0.2187	3 3/4	2 1/2	6	3 5/8
0.2244	3 7/8	2 11/16	....	....
0.2280	4	2 3/4	....	....
0.2344	3 7/8	2 5/8	6 1/8	3 3/4
0.2402	3 7/8	2 11/16	....	....
0.2460	4	2 3/4	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
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....	....	....	....	....
....	....	....	....	....

Terminology and Definitions

Drill—An end-cutting tool which consists of a shank, neck, body, and point. The neck is omitted on some sizes.

Body—That portion extending from the shank or neck to the outer corners of the cutting lip.

Shank—That part of the drill by which it is held and driven.

Neck—The diametrically relieved portion between body and shank.

Tang—The flat end of the shank, intended to fit into a driving slot in the drill holder or socket.

Point—The cutting end of a drill, made up of the ends of the land and the web forming the lip; usually, it is roughly conical in form.

Over-All Length—The length from the shank end to the outer corners of the cutting lips. It does not include the conical cutting point.

Flute Length—The distance from the outer corners of the cutting lips to the extreme back end of the flute.

Flutes—The helical or straight grooves cut or formed in the body of the drill to provide cutting edges, to permit removal of chips, and to allow cutting fluid to reach the edges.

Land—The periphery of that portion of the drill body not cut away from the flute.

Margin—That portion of the land which is not cut away to provide clearance. The margin forms the full diameter of the drill.

Body Diameter Clearance—That portion of the land that has been cut away so it will not rub against the walls of the holes. Sometimes called the "land clearance." Its purpose is to reduce friction.

Clearance Diameter—The diameter of the relieved portion of the drill.

Web—The central portion of the body that joins the land. The extreme end of web forms the chisel edge.

Web Thickness—The minimum thickness of the web at the point,

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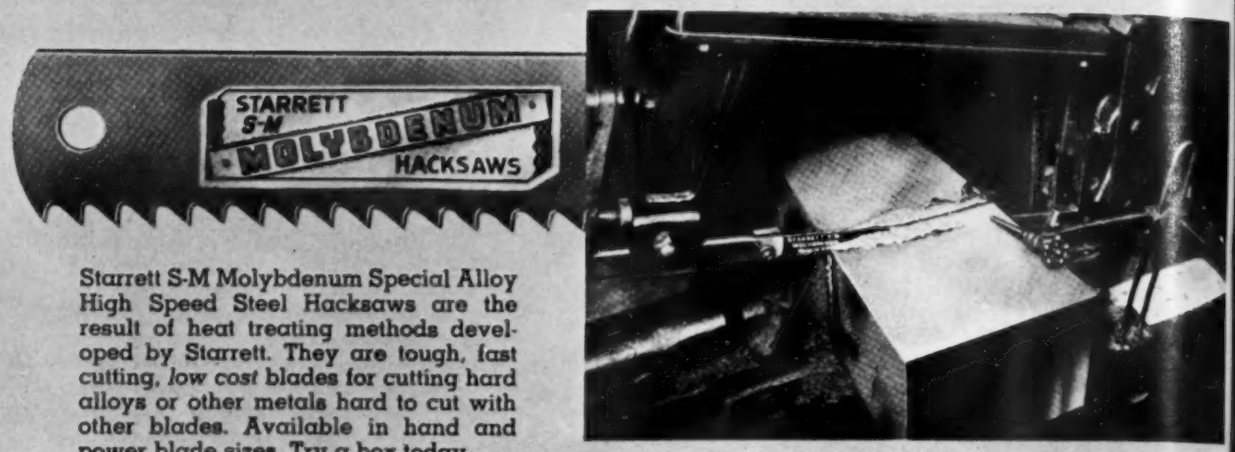
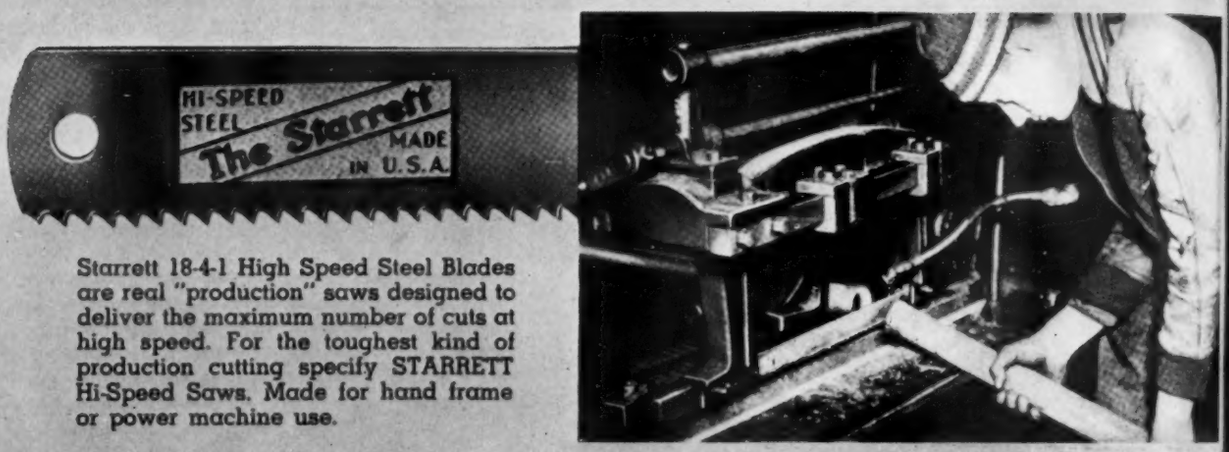


Starrett S-M Molybdenum Special Alloy High Speed Steel Hacksaws are the result of heat treating methods developed by Starrett. They are tough, fast cutting, *low cost* blades for cutting hard alloys or other metals hard to cut with other blades. Available in hand and power blade sizes. Try a box today.



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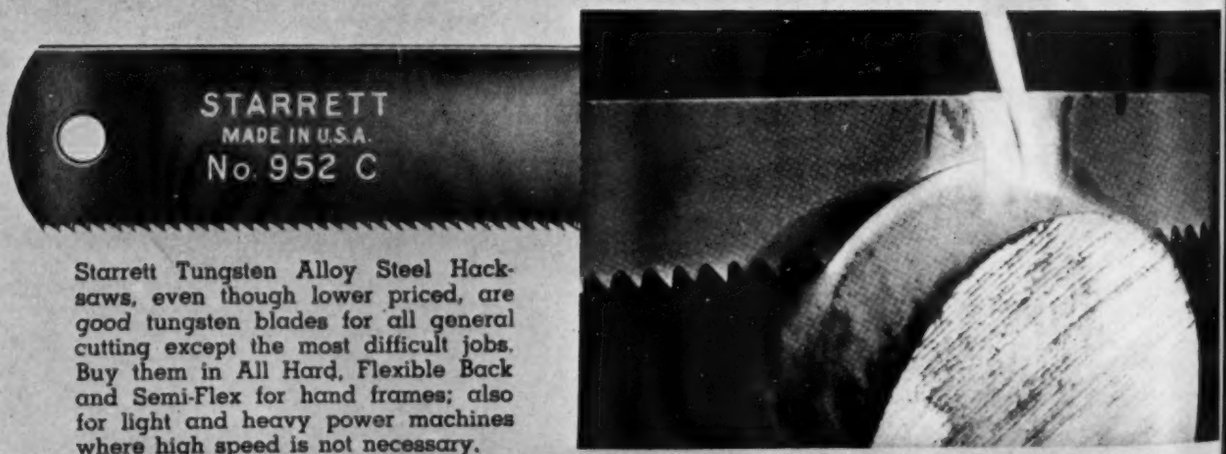

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Straight-Shank Drill Standards

unless another location is indicated.

Web Thinning—The operation of reducing the web thickness at the point to reduce drilling thrust.

Chisel Edge—The edge at end of web that connects cutting edges.

Lips—The cutting edges of the drill extending from the chisel edge to the periphery.

Helix Angle—The angle which the leading edge of the land makes with the axis of the drill. The helix angle is identical with the rake angle of the cutting edges at the periphery of the drill. A straight-flute drill would have no helix angle.

Rake Angle (*In Relation to Work*)—The angle between the leading edge of the land and the axis at the drill point.

Point Angle—The angle included between the lips.

Lip Relief Angle—The angle measured between a tangent at the surface back of the cutting edge at the periphery and a line at right angles to the axis of the drill.

Chisel-Edge Angle (*Center Angle*)—The angle included between the chisel edge and the cutting edge as seen from the end of the drill.

Back Taper (*Longitudinal Relief*)—Drills are usually made slightly smaller in diameter at the shank end than at the point; this is known as back taper.

Dimensions for 0.2500–0.500-in. diameter drills

Diameter of Drill	New Lengths				Conventional Lengths			
	Regular Series		Long Series		Jobber's or Short Series		Taper or Long Series	
A	Over-All Length B	Flute Length C	Over-All Length B	Flute Length C	Over-All Length B	Flute Length C	Over-All Length B	Flute Length C
0.2500	4 1/2	3 1/8	6 1/2	4 5/16	4	2 3/4	6 1/8	4
0.2520	4 1/2	3 1/8	....	....	4	2 5/8	....	....
0.2570	4 1/2	3 1/8	....	....	4 1/8	2 7/8	....	....
0.2610	4 1/2	3 1/8	....	....	4 1/8	2 7/8	....	....
0.2656	4 1/2	3 1/8	6 1/2	4 5/16	4 1/8	2 7/8	6 1/4	4
0.2720	4 1/2	3 1/8	....	....	4 1/8	2 7/8	....	....
0.2770	4 1/2	3 1/8	....	....	4 1/8	2 7/8	....	....
0.2812	4 3/4	3 3/8	6 3/4	4 1/2	4 1/4	2 31/32	6 1/4	4
0.2854	4 3/4	3 3/8	....	....	4 1/4	3	....	....
0.2913	4 3/4	3 3/8	....	....	4 1/4	3	....	....
0.2969	4 3/4	3 3/8	6 3/4	4 1/2	4 3/8	3 3/32	6 3/8	4 1/16
0.3020	4 3/4	3 3/8	....	....	4 3/8	3 1/8	....	....
0.3071	4 3/4	3 3/8	....	....	4 3/8	3 1/8	....	....
0.3125	5	3 5/8	7	4 11/16	4 1/2	3 3/16	6 3/8	4 1/16
0.3160	5	3 5/8	....	....	4 1/2	3 1/4	....	....
0.3230	5	3 5/8	....	....	4 5/8	3 5/16	....	....
0.3281	5	3 5/8	7	4 11/16	4 5/8	3 5/16	6 1/2	4 1/8
0.3320	5	3 5/8	....	....	4 3/4	3 7/16	....	....
0.3390	5	3 5/8	....	....	4 3/4	3 7/16	....	....
0.3437	5 1/4	3 7/8	7 1/4	4 15/16	4 3/4	3 13/32	6 1/2	4 1/8
0.3480	5 1/4	3 7/8	....	....	4 7/8	3 1/2	....	....
0.3543	5 1/4	3 7/8	....	....	4 7/8	3 17/32	....	....
0.3594	5 1/4	3 7/8	7 1/4	4 15/16	4 7/8	3 17/32	6 3/4	4 1/4
0.3680	5 1/4	3 7/8	....	....	5	3 5/8	....	....
0.3750	5 5/8	4 1/8	7 5/8	5 1/8	5	3 5/8	6 3/4	4 1/4
0.3860	5 5/8	4 1/8	....	....	5 1/8	3 3/4	....	....
0.3906	5 5/8	4 1/8	7 5/8	5 1/8	5 1/8	3 3/4	7	4 3/8
0.3970	5 5/8	4 1/8	....	....	5 1/8	3 3/4	....	....
0.4062	5 5/8	4 1/8	7 5/8	5 1/8	5 1/4	3 27/32	7	4 3/8
0.4219	5 5/8	4 1/8	7 5/8	5 1/8	5 3/8	3 31/32	7 1/4	4 5/8
0.4375	6 1/8	4 7/16	8 1/8	5 7/16	5 1/2	4 1/16	7 1/4	4 5/8
0.4531	6 1/8	4 7/16	8 1/8	5 7/16	5 5/8	4 3/16	7 1/2	4 7/8
0.4687	6 1/8	4 7/16	8 1/8	5 7/16	5 3/4	4 9/32	7 1/2	4 7/8
0.4844	6 1/8	4 7/16	8 1/8	5 7/16	5 7/8	4 13/32	7 3/4	5
0.5000	6 1/8	4 7/16	8 1/8	5 7/16	6	4 1/2	7 3/4	5

Axis—The longitudinal center line through the drill.

Kind of Shank

Straight-Shank Drills—Drills having cylindrical shanks. The shank may be the same or of a different diameter from that of the body of the drill. It may be made with or without driving flats, tang or grooves.

Taper-Shank Drills—Drills having conical shanks suitable for direct fitting into tapered holes in drilling machine spindles or driving sockets. The tapered shanks generally have a driving tang.

Taper Square-Shank Drills—Drills having tapered shanks with four flat sides for fitting ratchets and braces.

Number of Flutes

Two-Flute Drills—These are the conventional drills used for originating holes.

Single-Flute Drills—Drills used principally for drilling wood and other soft substances.

Three-Flute Drills (*Core Drills*)—These drills are used for enlarging and finishing holes. They will not originate holes because they do not have cutting edges at the center.

Four-Flute Drills—These drills are interchangeably used with three-flute drills. They are of the same construction as three-flute drills.

Rotation

Right-Hand Drills—The great majority of drills are made "right-hand"; that is, when looking toward the point with the shank extending away, they must be rotated in a counterclockwise direction.

Left-Hand Drills—These drills are made to cut when rotated in a clockwise direction; they are not used extensively.

Oil Holes

Some drills have holes through the solid metal or webs extending to the cutting lip. Holes may extend through the entire length of the drill or only through the body length.

Other drills have oil channels machined in the webs and covered. This type of drill is usually made in sizes larger than 2½ in.

DEPENDABILITY

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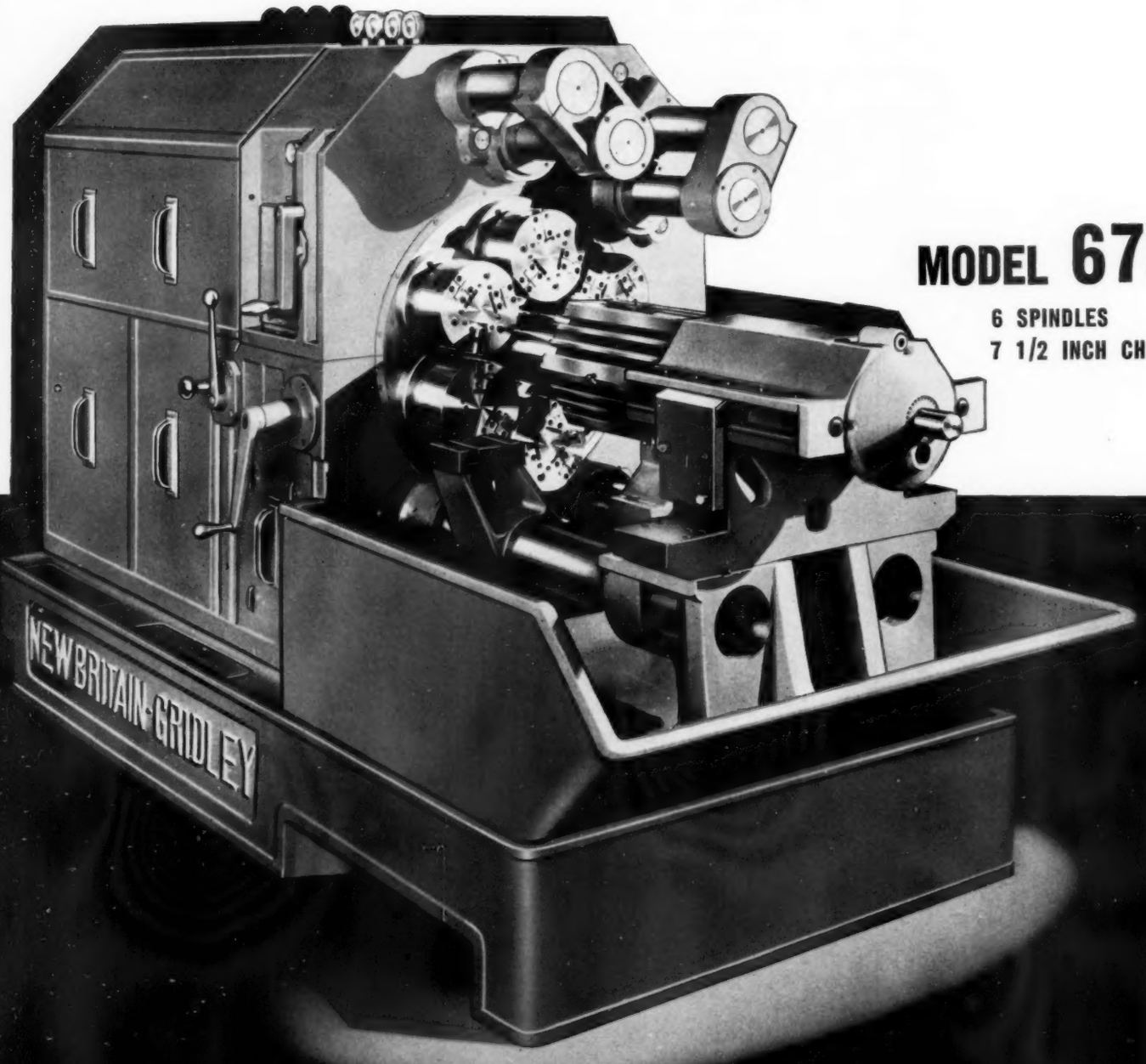

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No Bottleneck Here

TO SAY THAT an industry is a defense "bottleneck" these days is like pointing an accusing finger at a person and saying "convicted."

That's why we strongly resent the statement that the machine tool industry is a bottleneck. For it isn't.

True, the industry is sold out months ahead. True, if it falls down on its job, the defense program will be gravely delayed. But it hasn't fallen down on its job. Mr. Knudsen, among others, has publicly testified that the machine tool industry "is cooperating 100 per cent."

We'll wager that the industry, despite the unprecedented burden on it, will be able to furnish machines just about as fast as the munitions makers can take them.

If that is done, however, it is necessary that machine tool customers do some intelligent planning and that they view matters from the national interest as well as from their individual selfish standpoints.

Does this sound vague? Well, let's be specific. What good is served if Wright Field or any other military or naval establishment should order machine tools without having an immediate destination for them and then refuse to release them to an airplane maker who badly needs them at the moment? What good is served when the British take delivery on machines which are warehoused pending a decision as to their use, when the same machines could be put into immediate production elsewhere? What good is served when an airplane engine company demands prompt delivery of machine tools to a plant as yet unbuilt?

It's the old "bird-in-the-hand" philosophy at work. Don't let anything go that you can get your hands on, because you may not be able to secure the same thing later on when you need it. It's the same sort of thinking that sends housewives out to stock up on sugar when it appears sugar may be a little hard to buy.

But if it is going to be every man for himself, it will be too bad for the defense program. That kind of thinking will do irreparable harm.

Let's look at the matter sensibly. Take a company tooling up to make tanks, for example. Instead of insisting that all of its $10,000,000 of machine tools be in place before production starts rolling in a big way, why wouldn't it be a good idea to begin manufacture as soon as enough machines have been delivered to put together a line?

Inevitably errors will crop up. A certain machine set-up may be wrong or may need modification. Some cutting tools may have to be changed. A new coolant may be necessary for a particular operation. Changes in sequence may be advantageous. As these "bugs" are removed, more machines are being delivered and by the time operations are running smoothly, everything is in.

At best, tooling for defense can move only so fast. If we can do in two years what Hitler took seven years to do, that will be a record in itself. And the machine tool industry can perform its part in this program if it maintains its present pace.

As Boss Kettering has said, and Mr. Knudsen repeated recently, "Two hens sitting on a nest won't produce eggs in half the time."

Burnham Finney

GAGING BUSINESS

Industry begins to feel full impact of the defense program. User cooperation needed to place machine tools where they will do most good. British orders swell large outlay for armament.

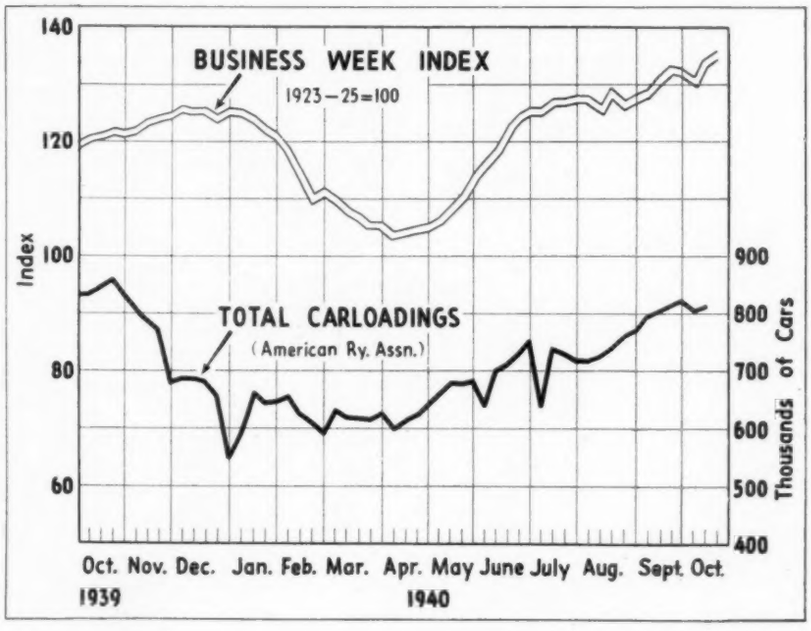
Machine Tools—More and more the industry feels the pressure of the defense program. Munitions contractors are getting orders for tanks, guns, shell and other armament items, and in turn are estimating their machine tool requirements. Four projects taken on by automobile companies will need equipment totalling in excess of $100,000,000. These projects include machine guns by General Motors, Pratt & Whitney engines by Ford, tanks by Chrysler, and Rolls Royce engines by Packard. In addition, machine tools valued at $20,000,000 will be needed by Wright Aeronautical for its new Cincinnati plant and for main subcontractors supplying parts to Cincinnati. Delivery of machine tools to defense contractors who need them immediately will be expedited if buyers will resist the temptation to demand their machine ahead of the date when they can be put to work. In several important instances machine tools have been warehoused pending installation when they might advantageously have been operated immediately somewhere else. If an orderly time-table is set up to conform with actual needs, machine tool builders are confident that they can handle defense orders without serious delay. The industry is now producing on the basis in excess of $450,000,000 a year, and will be above a $500,000,000 rate before long.

Farm Equipment and Tractors—Tractor manufacturers are now receiving some sizable defense orders. J. I. Case has been awarded a contract for 155-mm. shell valued at $4,634,000. International Harvester will forge and machine 75-mm. shell at its Milwaukee works on a recent order of approximately $1,000,000. The demand for industrial tractors continues to be good but can be handled along with the armament orders without interference.

Railroad Equipment—Buying orders are now being placed for next year's delivery as the added demand for defense items is also being felt by manufacturers of railway equipment. Contracts for forgings have been let to the American Forge Division, of the American Brake Shoe & Foundry Co., American Locomotive Co., and others. Several of Pullman-Standard's plants are in receipt of orders during the past few weeks. Infantry weapons costing $838,150 are to be manufactured at the Hammond plant, $638,150 for motors, $1,134,000 for artillery ammunition components at the Butler Division. Orders for track materials are beginning to come in for next year. The New York Central has ordered $6,650,000 worth. Southern Railway has ordered 35,000 tons of rail and the Rock Island railroad has authority to buy $3,075,000 worth of track material.

Munitions—The British have placed large orders for tanks with Pullman-Standard and with Baldwin Locomotive Works. Continental Motors is understood to have an order for engines totalling $20,000,000 for these tanks, and John Inglis Co., Toronto, will furnish Bren machine guns for them. Negotiations are now on for a contract covering transmissions for the tanks. International Motors is believed to have secured an order to make more tank transmissions though not for this British contract. One of the biggest problems confronting the government is the production of small arms ammunition and machine guns necessary to arm tanks, aircraft and other mobile equipment to be built during 1941. Shell contracts are being let in increasing volume by the Ordnance Div. of the War Department.

Aircraft—Preliminary studies for American air and fleet bases on British islands in the Atlantic show that at least $500,000,000 will be required to build them. Around $70,000,000 will be needed for the base at Trinidad alone. Extensive dredging, wharves, flying fields and other facilities are planned there. The money for the Atlantic bases has not yet been appropriated. Domestic flying fields and airplane servicing facilities are entirely inadequate to handle the number of planes it is expected will be delivered in 1941. Construction and equipping of such facilities takes time. Plans for their expansion are far below requirements. The Army and Navy have had to take over some fields already, among which is Floyd Bennett in New York. Many more will have to be used partially or entirely by the two arms of the service. Regular transport air lines can hardly escape interference at numerous ports from Army and Navy operations. Two additions to the Pratt & Whitney aircraft engine plant were dedicated last week by Major General H. H. Arnold, chief of the Army Air Corps. Known as the "British additions" because they were financed by British capital, these plants add 400,000 sq. ft. of floor space, and represent the third major increase in manufacturing capacity since January, 1939.



Defense Commission Sets Up Plan To Increase Skilled Labor Supply

WASHINGTON—A "Training within Industry" program has been set up by the Defense Commission. It is modeled on methods already in use by some manufacturers in urgent need of skills, and is commonly called "up-grading." In a word, the employer simply trains workers on minor jobs for promotion to jobs requiring greater skills, meanwhile feeding untrained men in at the foot of the line.

The program was started in a small way a couple of months ago. It is under direction of the Commissions Labor Division, which is headed by Sidney Hillman. The plan will be in full operation in another couple of months. It will be directed from 22 division offices to be set up in as many industrial regions.

Three men are in direct charge of the program: C. R. Dooley, industrial relations man for Socony Vacuum; Walter Dietz, personnel director of Western Electric; and William Conover, United States Steel of Delaware. These men are on loan to the Government, without pay.

The plan is to get men from industry, who have had the right type of personnel training experience, and have them serve as "instructors" for the various industrial regions. Actually, the Commission is serving as liaison between defense equipment manufacturers for the exchange of "up-grading" information. There are no appropriations involved and very little expense.

There is nothing new or experimental about this program; it's as old as apprenticeship. However, the plan is called into wide use now because of urgent need for more skilled men. The Defense Commission is now helping to guide such training in instrument making, in lens grinding, in airplane engine building, and other lines. In addition to regular up-grading, the Labor Division's program includes training workers in occupations requiring only a single skill, and developing supervisors by giving them progressively increasing responsibility.

Soviet Will Spend $30,000,000 In U. S. for Tools and Machinery

NEW YORK—Soviet orders for more than $9,000,000 of heavy equipment were placed in the U. S. last month and an additional $30,000,000 worth of goods will be purchased here before the end of the year. The Soviet buying is a direct result of the more lenient attitude taken by the government here in the matter of export licenses for the goods Russia needs. Earth-moving and hauling equipment, drilling machinery, and railroad equipment will be purchased in large quantities.

Voluntary System of Priorities Still in Effect Despite Appointment of Priorities Board

WASHINGTON — Headlines to the contrary, the President's appointment of a priorities board and naming as priority administrator Donald Nelson, Defense Commission procurement coordinator, makes no concrete immediate change in the priorities situation. Still in effect and still voluntary is the voluntary priority system instituted by the machine tool industry some months ago. Nelson tells AMERICAN MACHINIST that he has no specific case in mind in which to recommend further priorities to the board which is composed of defense commissioners Knudsen, Stettinius, and Henderson.

Immediate duties of the board and administrator, according to Nelson, will be (1) to establish policies, (2) to adjust problems between contractors and Army and Navy that cannot be settled by the priorities committee of the Army and Navy Munitions Board, and (3) to handle problems outside the jurisdiction of the Army and Navy committee.

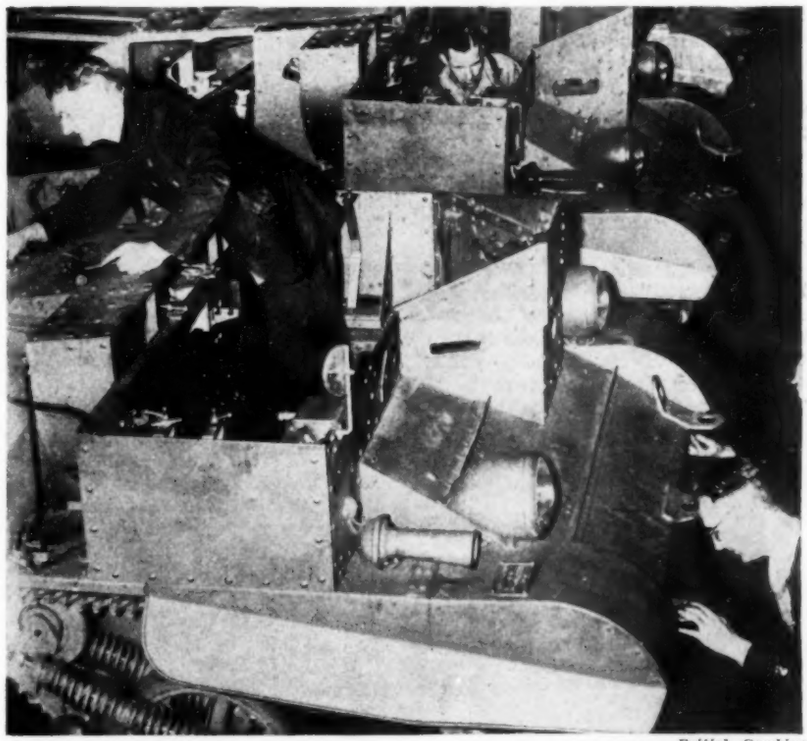
Major significance of the appointments, apart from a somewhat political timing, is that responsibility for priorities is shifted from military to civilian hands. This foreshadows the increasing necessity for coordinating civil and military needs as opposed to mere relative scheduling of different military orders.

Along the same line was Nelson's simultaneous appointment of Albert J. Browning of Montgomery Ward, to represent Nelson in his capacity as procurement coordinator in the Quartermaster's office. The commission has several times lately taken occasion to spank the Army publicly for pushing out orders so timed as to disorganize the markets.

The President's move does however, bring mandatory priorities one technical step nearer. It also sets the machinery to study some of the questions now arising, such questions as what to do about sub-contractors who need a higher priority than their prime contractor, what to do about occasional violations that are cropping up.

LARGE AMMUNITION ORDERS

WASHINGTON—The War Department has recently ordered artillery ammunition components valued at approximately $67,000,000. Among firms receiving large orders are: Eastman Kodak Co., Rochester, N. Y., $12,000,000; Budd Wheel Co., Detroit, $7,813,380; Tennessee Coal, Iron & R. R. Co., Birmingham, $5,823,600; and Willys-Overland, $5,100,040.



British Combine

Tanks for England—*In Australia the munitions industry has been growing ever since England's entry into World War II. Tanks, guns, shells and soldiers are being sent to Britain to help in the struggle. Above, a line of light tanks near completion at an ordnance factory in Melbourne*

Machine Tool Builders in Convention Discuss Relation of the Industry to Defense Problems

CHICAGO—National defense occupied the attention of machine tool builders to the exclusion of all other matters at the thirty-ninth annual convention of the National Machine Tool Builders' Association at the Edgewater Beach Hotel, October 24-25. An entire session was given over to an off-the-record discussion of defense problems as they impinge on the machine tool industry. A large portion of the program the second day also was devoted to defense matters, including an open forum discussion.

"We want it definitely understood that insofar as the national defense program depends on the machine tool industry, we are resolved that we shall not be found lacking, and that as individuals, as companies or as an industry, we will find the means to furnish the machine tools needed," declared John E. Lovely, president of the association and vice-president, Jones & Lamson Machine Co., in his address "Essential Elements of a National Defense Program."

Machine Tool Industry Capable

"So far we have taken care of all demands made on us. We will continue to do so if an orderly program is presented and planned out a reasonable time in advance. What the eventual size of the defense program will be, only coming world events will reveal. If it is limited to the program covered by legislation already passed, we are confident our industry will take it in its stride. If the present program is merely a starter, then I know ways will be found of taking care of the added problems as they materialize."

Mr. Lovely said that "We are keenly conscious that on our industry alone falls the responsibility for supplying the machine tools needed by the defense of our country. The manufacture of machine tools is so technical and highly specialized that only those experienced in it can solve the problem." He said further that "The intensive development here of high production machine tools has been both the cause and the result of the tremendous industries in the United States. Our machine tool industry has been developed to take care of the demands of our own huge industries and at the same time has served the demands in other countries. We are now actually hitting our stride in converting this huge industrial capacity, the greatest in the world, to production of material for defense."

The speed and power of the defense program, declared Mr. Lovely, "involve the solution of great engineering problems. These problems are not yet fully recognized. It seems obvious that what the defense program needs is a clearly defined program and a clearly defined time table. The biggest need of our industry is to know what our full task is to be, and when it should be done."

FREDERICK V. GEIER

The preference system for machine tools, whereby the Army and Navy Munitions Board is setting priorities on all of its requirements, is the result of fine cooperation between army and navy officers, members of the National Defense Advisory Commission and the industry, said Mr. Lovely. The two service branches appreciate the importance of the new instruments of mechanized warfare and realize that warfare must now be conducted by machines.

Mr. Lovely recited that fact that, just as the industry is embarking on the defense program, it is operating at a higher rate than ever before in its history to a large extent because of the recent demand for machine tools from abroad. If that export business had not been available, the industry would be in a poor position today to take care of the extraordinary requirements of the defense program. The industry produced $185,000,000 of machine tools in 1929, sank to $22,500,000 as an annual average for 1932 and 1933, rose to $85,000,000 in 1935, and in 1937 went up to $220,000,000. Output in 1938 fell to $120,000,000, a large portion of which was for foreign delivery. In 1939, thanks again to export orders, production increased to $200,000,000. This year total output will be an all-time high or roughly $400,000,000. In August the industry was turning out machine tools at a rate of $450,000,000 a year, just double the rate of August 1939. Production in 1941 will greatly surpass that figure.

L. W. SCOTT ALTER

Expansion Problems Cited

Present output can be increased, states Mr. Lovely, "by the additional use of existing plants and facilities, by farming out work to more subcontractors, and by the further expansion of some of our plants and the addition of still more equipment. All three methods have been employed the past year and will be continued."

Many machine tool builders, said Mr. Lovely, "have expanded their plants and purchased additional machine tools to increase their own capacity before they were sure that their purchases would be needed, before they knew what the rules of the game would be, before knowing what

CLIFFORD STILLWELL

ELECT NEW OFFICERS

CHICAGO—Frederick V. Geier, Cincinnati Milling Machine Co., has been elected president, and Clifford Stillwell, Warner & Swasey Co., first vice president of the National Machine Tool Builders Association. Other officers include: George H. Johnson, Gisholdt Machine Co., second vice president; E. C. Bullard, Bullard Co., treasurer. L. W. Scott Alter, American Tool Works Co., and David Ayr, Hendey Machine Co., have been named directors for three years.

DAVID AYR

the rate of tax would be, and before they knew how they were going to pay for the added facilities they were acquiring. We know our industry is over-expanded already for the normal peacetime business of the country and that therefore the expansions which have been made to take care of the defense program and the further expansions that may become necessary should qualify for certification under the terms of amortization in the new tax bill.

"Our plants must be maintained in liquid condition and kept in workable order. It is not only a fair thing, but a vital thing to our country that our industry be maintained in a healthy condition. The rush of work prevents operation at maximum efficiency. The forced training of new men and the necessity of using newly trained men results in a loss of time and spoilage of work if not kept in proper bounds. We do feel, therefore, that government must be sympathetic to business and that business must be treated in such a manner that it will survive this emergency rather than be sacrified to the emergency."

It is apparent that no one knows what machine tools will be required until the defense program has developed to a point where it is definitely known what types of machine guns, aircraft and tanks are actually to be ordered, what the designs will be and what the quantities of each type will be, remarked Mr. Lovely. "Contracts must then be awarded to the people who will make them, after which each contractor must find out how to make what he is to build, what machine tools he will need for each component part, what existing machine tools are available, and what added machine tools he must order.

"These vital new machine tools must be made of the right size and type, and each must be equipped in such a manner that each will do its appointed job. Until the program reaches the stage where each individual contractor can place his orders for the exact machine tools he needs, the machine tool builder is unable to plan his part of the program. We are just reaching this stage."

U. S. Government Contracts Awarded to Metal-Working Firms

Contractor	Gov't Agency	Commodity	Amount
International Flare Signal Div., Kilgore Mfg. Co., Tippecanoe City, Ohio	War	Ammunition components	$124,530
Allis-Chalmers Mfg. Co., Milwaukee, Wisc.	Navy	Forgings	178,350
Heppenstall Co., Pittsburgh, Pa.	Navy	"	832,996
The American Brass Co., Waterbury, Conn.	War	Cartridge cups	418,575
Revere Copper & Brass, Inc., Baltimore, Md.	War	"	268,100
Monarch Machine Tool Co., Sidney, Ohio	Navy	Lathes	119,463
W. E. Shipley Machy Co., Philadelphia, Pa.	War	"	118,415
Goss Printing Press Co., Chicago, Ill	Navy	Plant equip.	505,490
Pump Engineering Service Corp., Cleveland, Ohio	War	Pumps	184,872
Boeing Airplane Co., Stearman Aircraft Div., Wichita, Kan.	War	Airplanes	6,934,096
General Motors Corp., (Chev. Div.), Detroit, Mich.	War	Trucks	10,050,418
National Pneumatic Co., Inc., Rahway, N. J.	War	Artillery material	178,300
Ransome Concrete Machine Co., Donellan, N. J.	War	"	146,893
Hannifin Mfg. Co., Chicago, Ill.	War	"	384,279
Western Austin Co., Aurora, Ill.	War	"	240,280
Cleveland Tractor Co., Cleveland, Ohio	War	Tractors	185,747
Charles Fischer Spring Co., Brooklyn, N. Y.	War	Small arms material	101,880
Bohn Aluminum and Brass Corp., Detroit, Mich	War	Ammunition components	117,685
Delco Products, Div. of General Motors Corp., Dayton, Ohio	War	" "	445,656
Worth Steel Co., Claymont, Del.	Navy	Steel	1,343,095
Carnegie-Illinois Steel Co., Washington, D. C.	Navy	"	4,826,464
National Pneumatic Co., Inc., Rahway, N. J.	War	Guns	5,994,526
York Safe & Lock Co., York, Pa.	War	"	2,914,724
General Electric Co., Schenectady, N. Y.	War	Howitzers	1,759,826
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.	Navy	Boring mills	134,600
American Car & Foundry Co., Buffalo, N. Y.	War	Ammunition components	6,040,000
Armstrong Cork Co., Lancaster, Pa.	War	" " "	822,000
Babcock Printing Press Corp., New London, Conn.	War	" "	607,500
National Supply Co., Spang Chalfant Div., Ambridge, Pa.	War	" "	501,500
S. A. Woods Machine Co., Boston, Mass.	War	" "	1,501,344
J. I. Case Co., Racine, Wisc.	War	" "	4,634,500
National Tube Co., McKeesport Plant, McKeesport, Pa.	War	" "	3,365,000
General Railway Signal Co., Rochester, N. Y.	War	" "	2,975,000
Pratt Industries, Inc., Frankfort, N. Y.	War	" "	236,241
National Tube Co., Pittsburgh, Pa.	War	" "	264,147
Lansdowne Steel & Iron Co., Morton, Pa.	War	" "	176,640
Yellow Truck & Coach Mfg. Co., Pontiac, Mich.	War	Trucks	104,952
Struthers Wells-Titusville Corp., Titusville, Pa.	War	Artillery material	127,000
Bethlehem Steel Co., San Francisco, Calif.	Navy	Tools, equipment, etc.	10,013,000
Bethlehem Steel Co., Quincy, Mass.	Navy	" " "	13,427,500
New York Shipbuilding Corp., Camden, N. J.	Navy	" " "	10,590,000
Bethlehem Steel Co., Staten Island, N. Y.	Navy	Cranes, machinery	2,706,000
Gulf Shipbuilding Corp., Chickasaw, Ala.	Navy	" "	2,500,000
Seattle-Tacoma Shipbuilding Corp., Seattle, Wash.	Navy	Plant facilities	4,600,000
Electric Boat Co., Groton, Conn.	Navy	" "	2,750,000
Consolidated Steel Corp., Orange, Texas	Navy	" "	4,600,000
Manitowoc Shipbuilding Co., Manitowoc, Wis.	Navy	" "	1,000,000

More New Canadian War Plants Begun; Will Produce 3,000 Tanks

MONTREAL—To date the British and Canadian governments have made commitments of $250,000,000 for the construction of new war plants in Canada. The plants will be government owned. War orders placed to date by Canadian Dept. of Supply (or predecessors purchasing boards) approximate $550,000,000, of which 86 per cent have been awarded to Canadian concerns, 9 per cent to England and 5 per cent to the U. S.

Latest of Canada's war production plans include the output of 3,000 tanks for which $150,000,000 will be needed to provide necessary facilities. The government has given Canadian Vickers Co., Montreal, an order for six large steam-driven minesweepers for the Canadian Navy, to cost $600,000 each, as part of its $60,000,000 ship building program. Naval boats now ordered from Canadian shipyards total 98, including 34 minesweepers, 10 submarine chasers, and 64 corvettes.

Canadian aircraft companies expect to be producing 350 to 380 airplanes a month by early 1941, if they can continue to get the necessary trained labor. The production schedule for next year calls for 4,200 to 4,500 planes, ranging from light pilot trainers to heavy bombers. By the end of this year 1,300 planes will have been turned out.

Recent orders given by the Dept. of Munitions and Supply are: Aircraft, Aviation, Aviation Electric, Ltd., Montreal, $50,065; National Steel Car Corp., Ltd., Malton, Ont., $10,324; Canadian Car & Foundry Co., Ltd., Montreal, $632,205; and Noorduyn Aviation Ltd., Montreal, $21,944. Machinery, Williams & Wilson Ltd., Montreal, $85,436; Canadian Fairbanks-Morse Co., Ltd., Ottawa, $133,331; Modern Tool Works, Toronto, $148,651; J. H. Ryder Machinery Co., Toronto, $118,987; John Bertram & Sons Co., Ltd., Dundas, Ont., $556,331; Ford Motor Co. of Canada, Ltd., Windsor, Ont., $250,000; and John E. Livingstone Machinery Co., Ltd., Windsor, Ont., $140,135. Ordnance, British War Office, $1,060,000; and Hugh Carson Co., Ltd., Ottawa, $11,000.

Engineering Education Main Topic
At Recent A.S.T.E. Semi-Annual Meeting

CINCINNATI—Tours through fourteen local plants, technical sessions on gear finishing, a forum on engineering education, and a convention dinner kept members of the American Society of Tool Engineers busy during their three-day, semi-annual meeting held here Oct. 17, 18 and 19. Whiting Williams, noted industrial consultant, writer and lecturer was the principal speaker at the dinner Friday evening.

The Thursday evening session on education included talks by F. E. Searle, head of Ford Trade School, Dr. R. C. Gowdy, dean, College of Engineering and Commerce, University of Cincinnati, W. S. Dowman, assistant director of sales and office personnel, the Goodyear Tire & Rubber Company, and George Shiele, chief inspector, Cincinnati Milling Machine Company. The subject of the forum was "Should Industry Assume the Burden of Special Education."

Favor Industrial Training

In the preliminary report of the Society's Committee on Education, presented at the dinner on Friday Evening by H. D. Hall, committee chairman, it was indicated that the committee favors courses in high schools and colleges which would prepare the average student for any kind of situation in industrial plants. The Committee has suggested the possibility of combining the best features of vocational training and general academic studies in high school curriculum.

In his report to the Society, President A. H. d'Arcambal, emphasized the problem faced by the metal-working industry in the shortage of skilled men. A recent A.S.T.E. survey found a shortage of 40,000 tool engineers, 125,000 tool and die makers, and 400,000 skilled workers. Mr. d'Arcambal estimated that these figures probably can be doubled because of the added demand for workers needed to man plants being constructed under the Defense Program.

Speakers at the Saturday morning technical session on gear finishing included Charles R. Staub, chief engineer, Michigan Tool Co., Otto H. Schafer, president, Schafer Gear Works, I. J. Gruenberg, chief engineer, Gear Grinding Machinery Company, and Charles Pfeffer, gear development and production, Wright Aeronautical Corporation. Most of the discussion was given over to consideration of shaving, lapping and grinding processes as applied to gear finishing problems.

B. B. Quillen (above), president, Cincinnati Planer Co., welcomed A.S.T.E. members at the dinner on behalf of the Cincinnati machine tool industry

At the left, A.S.T.E. president A. H. d'Arcambal had time for a joke with A.S.T.E. members B. G. Tang of General Electric Co. and J. R. Weaver of Westinghouse Electric & Mfg. Co.

At the right, Jack C. Carlton, president, Carlton Machine Tool Co.; Ross S. Hambleton, machine shop superintendent, at Wright Aeronautical's new plant in Cincinnati; and P. W. Brown, general superintendent, Wright Aeronautical Corp., came early for the A.S.T.E. dinner Friday night

Speakers at the session on gear finishing were I. J. Gruenberg, Gear Grinding Machinery Co., and C. Pfeffer, Wright Aeronautical

Charles R. Staub and executive v-p Marvin Anderson, Michigan Tool Co., were co-authors of a paper on gear finishing

O. H. Schafer, Schafer Gear Works, and R. M. Lippard, Heald Machine Co., were among the more than 500 registered

WATCHING WASHINGTON

Attempt to deny defense orders to violators of Wagner Act has brought no definite results. Aluminum and Tin facilities will be greatly expanded in U. S. Lag seen in airplane production

By BLAINE STUBBLEFIELD

WASHINGTON—The Hillman-Jackson attempt to enforce the Wagner Act by having the federal procurement agencies refuse orders to firms accused of violating the Act, still has brought no definite results. It is the type of thing that politicians let ride down the middle of the road and that is what they are still doing, as AMERICAN MACHINIST predicted in its last issue. Following the publicly expressed wish of Sidney Hillman that low-bidder awards, as well as negotiated awards, be refused to law violators, Sec. of War Stimson, has now asked the U. S. Comptroller General Elliot for a ruling on that question. But is is believed here that Stimson merely wanted to get cleared legally for any case that might come up. The Comptroller General is often asked such important questions, because he must see that all moneys are disbursed according to law.

Mr. Elliot's reply boils down to this: Under defense law, the procurement agencies have the right to reject *all* bids and negotiate with bidders or non-bidders on the terms advertised. Therefore, there is no legal prohibition against the rejection of low bids which are consistent with principles applied in negotiation of awards. In other words, the bid system still exists only as a formality, though many administrators, such as Donald Nelson, co-ordinator of defense purchasing, see danger in its abandonment.

Opinion here is that NLRA violators will be admonished quietly by the Army-Navy-Defense Commission team to be good. Openly recalcitrant manufacturers may be publicly denied orders to placate organized labor. If you are trying to figure it out along normal lines of thought, just remember that on one hand you have a law under which the Government can confiscate plants for refusal to take orders, and on the other, a law that threatens to deny orders to firms. Actually, there will be very little confiscating and very little order-refusing.

Aim Plane Standards at Britain

The committee on standardization of plane output appointed by the President (Knudsen, Stimson, Knox, Morgenthau) has little to do with standardization of airplane types. However, the administration is not averse to letting the public, thoroughly sold on that objective, get such an impression. Real purpose is to put some high-power names behind an effort to get the British to accept U. S. standards as to details of the planes they buy. This is particularly important in cases where the British are buying substantially the same ship as this government, such as the Curtiss P-40 or the Bell P-39.

Brunt of this effort falls on the standardization committee of the Army-Navy Aeronautical Board; this committee works on the interchangeability of parts as between different Army, Navy, and British models. At present it is working at the level of the thread of screws and the location of holes on a generator pad; eventually it will work as far up toward more important sub-assemblies as it can go without upsetting production.

Plane Output Lag Hurts Britain

Hardest hit by the current lag in airplane production behind the scheduled rate are the British. Total output, scheduled to rise from 900 units in August to 1,150 in October and 1,250 in January is actually riding along at 900 to 950 ships. Even worse, from the British viewpoint, total production is only holding constant because a rise in trainer output is compensating for an actual drop in production of combat types. These are naturally most affected by re-tooling and plant expansion interference. And for the present, production for Britain is almost synonomous with production of combat types. In August, the British and Canadians received 350 planes, but in September this dropped below 300; it is unlikely to rise much beyond this in October.

These initial delays, however, are unlikely seriously to affect the fulfillment of the two-year program. This calls for a total production by July 1942 of 35,800 units—though if hoped-for schedules are achieved this output may be accomplished a few months earlier. Of these, Britain will get 14,300, by present plans, consisting of 11,870 combat ships and 2,430 trainers. The Air Corps, which has already placed orders extending beyond the 35,000-plane program, will get 8,225 combat ships and 6,175 trainers during the next year and a half—a total of 14,400. Navy ships, totalling 7,100 will be divided between 5,325 combat types and 1,775 trainers. Navy, incidentally, has so far scheduled only about 6,000 of its planes and has not awarded contracts for all of these.

SEE AID FOR MACHINE INDUSTRY

WASHINGTON — Government authorities close to the President have come to the conclusion that the machine productive capacity of the country should be carried by the government at whatever level above peace time needs may be necessary to avoid such a lack as is now being experienced. In their opinion it is better for the government to carry the burden of the supporting of the excess capacity than to go to the great cost of obtaining the capacity when needed. The safety of having the output would entirely offset any annual outlay for the maintenance involved. There is no need for the government to have any say in the operation of the business it would assist.

Increase Aluminum and Tin Supply

New steps have been taken to provide adequate supplies of aluminum and tin, both vital to defense. Stettinius announces that Aluminum Company will add three new units to its Bonneville and Alcoa plants, which will increase production by 90,000,000 pounds annually. This country's aluminum capacity in 1939 was 325,000,000 pounds; present capacity is 450,000,000; by July 1942 it will be 700,000,000 pounds.

Stettinius said we have an adequate supply of bauxite, and that increasing facilities for fabricating sheets, shapes, forgings, castings from ingots will meet defense needs. About 55% of bauxite comes from Dutch Guinea and most of the balance from Arkansas. Aluminum Company also filed with Federal Power Commission its intention to construct a 100,000 kw hydro-electric project near Alcoa, N. C., for completion in three years.

With $15,800,000 loan from RFC, Reynolds Metals Company starts immediate construction of a plant at Sheffield, Ala., to be in production in 1941, with a capacity of 60,000,000 pounds annually.

RFC's Metals Reserve Company has agreed with producers in Bolivia to purchase enough concentrates to smelt about 18,000 tons of fine tin per year for five years.

National Metal Show Introduces Materials And Methods to Aid National Defense

CLEVELAND, OHIO—Proper utilization of metals for items of national defense was the central theme of the National Metal Congress held at Cleveland, October 21-25. The Congress included the National Metal Exposition and technical sessions arranged by the four sponsoring societies, the American Society for Metals, the American Welding Society, the Wire Association and the American Institute of Mining and Metallurgical Engineers.

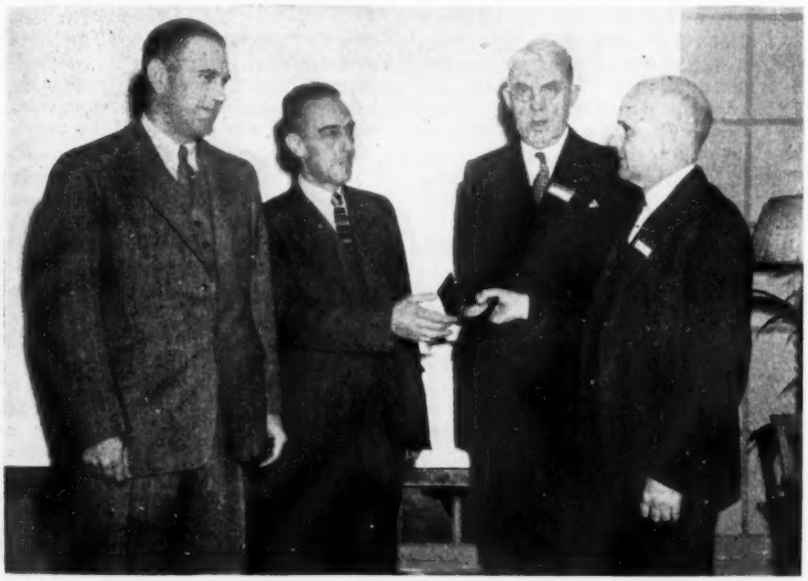
Heat-treating equipment exhibited at the show reflected further refinements in the control of furnace atmospheres to give the proper chemical relation between metal and gas during the heating cycle. Westinghouse demonstrated its Endogas furnace which produces clean and scale-free hardened steels. The atmosphere obtained from fuel gas in a reaction unit is controlled by a direct reading gage to give the desired "carbon balance." The Ammogas process, shown by the same manufacturer, is designed for the bright hardening of dies.

The "Bell-Oven" furnace, displayed by American Gas Furnace Co., has a covering or bell over the work resting on the furnace hearth. The desired atmosphere is inserted from above. The bell is automatically raised when the furnace door is opened but at other times protects the work by means of a gas-tight seal. Despatch Oven Co. demonstrated further refinements in its line of recirculating air furnaces which are particularly adopted to heat-treating and annealing non-ferrous metals such as aluminum alloys, brass, copper and bronze. In these furnaces combustion takes place in a separate chamber and is circulated around the work by means of forced draft to give uniform heating. The Lindberg Engineering Co. showed the "Cyclone" forced circulation electric tempering furnace developed for the heat-treatment of parts for the aircraft industry.

The feature of Surface Combustion Co.'s booth was its automatic annealing unit for wire, also suitable for tinning or enameling. The wire is heated directly in a gas flame and quenched in circulated water while unreeling from one spool and winding on another.

A vertical furnace for wire and strip annealing was displayed by the Selos Co. This unit combines continuous operation with the use of the radiant-heat gas burner introduced by this concern. A muffle furnace operating directly from city gas without the use of fans or blowers, was shown by Charles A. Hones, Inc., for use on high-speed steels.

The Ohio Crankshaft Co. has extended its line of Tocco Jr. induction machines for the surface hardening of small parts. By the use of simple fixtures, these units are applicable to a wide variety of work. Induction heating is used also by the Ajax Electrothermic Co. for heating steel bars to forging temperature in the manufacture of shell. Another method for raising shell stock to forging temperature has been developed by the Electric Furnace Co. This method uses a special rotary furnace and has been applied to the heating of 155-mm. shell.



T. N. Armstrong, Jr. and H. J. French, International Nickel Co., receive the Lincoln Gold Medal from Professor Le Roy W. Clark, Rensselaer Polytechnic Institute, while George T. Horton, retiring president, American Welding Society looks on

S. O. Bjornberg and F. W. England were justifiably proud of the gear measuring devices introduced by the Illinois Tool Works

Among the advances in temperature control devices was that shown by C. J. Tagliabue Mfg. Co., which gives multiple indicating control for six furnaces in one instrument. Successive readings for each furnace are given by a series of lights which indicate the furnace being measured and whether it is below, above or within the required temperature.

In the field of oxyacetylene welding, chief emphasis is placed on flame-cutting, flame machining and flame hardening. The Air Reduction Co. had nineteen different models of flame-cutting machines alone, including templet cutting, structural shape cutting and other devices. Also exhibited was a flame-hardening machine for handling round sections in a vertical position. The Linde Air Products Co. demonstrated a flame-cutting machine which will automatically cut either square or round sections. This unit is particularly suitable for cutting off stock for the manufacture of shell forgings.

The National Cylinder Gas Co. now distributes electric welding equipment through its subsidiary, the Hollup Corporation. This concern showed a multiple flame-cutting machine using four torches simultaneously. Una Welding, Inc., displayed a new portable welding unit complete with speed controls and automatic feeds. The flux is spread in ribbon form and wrapped around the bare rod, making possible some 80 combinations to suit specific materials.

General Electric Co. has developed new lines of welding electrodes suitable for national defense.

A new coated aluminum-bronze welding rod supplied by Ampco Metal, Inc., may be used for arc or gas welding without preheating the base metal. Six grades are available.

The rods are useful in coating surfaces of large forming dies.

Sciaky Corporation showed for the

T. C. Smith, J. J. Warren and A. F. Moranty (left to right) help display Leeds and Northrup's line of furnaces and temperature control instruments. C. H. Stevenson, R. S. Aitcheson and L. A. Lindberg were on hand to explain Lindberg Engineering Company's new developments. W. J. Donnelly, Charles J. Hones and Charles A. Hones showed gas fired furnaces at the Charles A. Hones Inc. exhibit

first time in this country its spot welding machine which was developed in France and is now coming into use in the aircraft industry for welding aluminum alloys and stainless steels. Also being applied to armament manufacture is the resistance welder made by Federal Machine & Welder Co. for use on projection, strap and butt welding. This equipment makes use of the condenser discharge which permits its use on standard line voltages. Progressive Welder Co. attracted attention with its hammerweld machine particularly useful on heavy stock and where scaly conditions exist.

The Master Mind shown by Harris Calorific Co. uses a signal system to measure the efficiency of a welder's work during the process of welding. A red light flashes on when the flow of metal across the arc is not satisfactory, giving a poor weld. A green light indicates a good weld. Timing clocks can be used in the circuit to record the final ratio of good and bad welds.

In the development of new metals attention has been given to alloys which are not dependent on imported materials that might be difficult to secure during an emergency. The Otis Steel Co.'s Otiscoloy, a low alloy, high tensile steel, is said to have exceptional welding properties because of the absence of hardening elements.

Chromium-boride alloys previously, marketed as hard facing compounds under the name of Colmonoy, are now available as sand castings furnace-welded to back-up pieces. The material has been found useful on such parts as centerless grinder rests, gages, steam valve seats and chuck jaws. Revere Copper and Brass Co. has developed a 90 per cent copper, 10 per cent aluminum alloy which forges readily. It has high physical properties with a yield point of about 35,000 lb. per sq.in. Chase Brass and Copper Co. has a new silicon-bronze welding rod designed for the oxy-acetylene welding of red brass and copper. This concern has also developed a new tellurium copper combining forgeability and machinability.

Stamping dies for sheet metal may be made quickly and cheaply through the use of "Kirksite A," a new alloy developed by the National Lead Company. This method is applicable in forming aluminum sheet for aircraft.

In the field of metal finishing, duPont demonstrated a novel process of plating brass two to four times as fast as older methods. The method gives a bright finish with heavier deposits than have heretofore been possible. National Machine Works showed an immersion heater for pickling tanks. The heating element is incased in a housing of bonded graphite which withstands the acid.

Devices for testing displayed at the show include Sperry Products detectors for flaws in steel. This method is particularly adaptable for the mill inspection of steel tubes by means of electric detection coils, which operate a signal lamp and stop the feed of material as soon as a flaw has been encountered. The Brush Development Co. demonstrated its method for the measurement of surface finishes. The surface analyzer employed has a sapphire tracer point which transmits its motion through an amplifier to an oscillograph to give an exact record of surface roughness.

The Metal Congress saw the installation of Dr. O. E. Harder, Battelle Memorial Institute, as new president of the A.S.M. The annual dinner at which Dr. Harder took office was addressed by General Hugh Johnson. The Campbell Memorial Lecture was delivered by S. L. Hoyt, also of the Battelle Memorial Institute. A. W. Machlet was awarded the Sauveuer medal.

A. W. S. awards included the Lincoln gold medal which went to H. J. French and T. N. Armstrong, Jr., both of the International Nickel Co. Their paper "Weld Hardening of Carbon and of Alloy Steel" was considered the year's outstanding contribution. The Samuel Wylie Miller memorial medal went to William Spraragen, technical secretary of the American Welding Society and editor of *The Welding Journal*.

W. B. Pierce and R. W. Dietrich (left to right) kept busy in the Rustless Iron and Steel Corporation's booth. Dr. E. C. Bain, U. S. Steel Corp., flexes a rapier made by the Austempering process of which he is co-inventor. D. G. Clark and Malcolm Judkins explained the merits of Firthite and other Firth Sterling Steel Co. products

Associated Machine Tool Dealers Discuss National Defense Problems at Annual Meeting

DAYTON, OHIO—Problems of national defense affecting the machine tool industry formed the main discussions at the annual meeting of the Associated Machine Tool Dealers of America at the Dayton Biltmore Hotel October 21-22. In addition to the two-day sessions and the dinner, a trip to the Monarch Machine Tool Co. at Sidney, Ohio, as guests of Wendell E. Whipp, president, was a feature of the convention.

Defense demands on the machine tool industry will amount to $600,000,000 a year for the next two years, predicted A. B. Einig, Machine Tool Division, National Defense Advisory Commission. In general, machine tool deliveries are now extended to about the middle of 1941. He emphasized that buyers must have the vision to anticipate their machine tool demands sufficiently far ahead; if they do, there will be no serious jam in the industry.

Mr. Einig estimated that gage requirements for defense the next two years will total $16,000,000. Gage makers today are turning out $4,000,000 of goods annually and may be able to get up to $6,000,000. This country has the task of creating two new industries: one for manufacture of precision instruments which can no longer be obtained from France and Switzerland, and the other for production of industrial jewels.

Increase Machine Tool Output

Machine tool builders have done a fine job, in Mr. Einig's judgment. Today the industry is employing upward of 70,000 men and its productive capacity is far in excess of 1917, the last time that a national emergency existed. It has enlarged its output from $22,000,000 a year in 1932 to $400,000,000 this year.

W. E. Whipp, president, Monarch Machine Tool Co., and John Sauer, Jr., Peninsular Machinery Co., Detroit, attended the meeting

If machine tool users will be satisfied to get enough machines to start a line, such as for tanks, and then discover the inevitable errors in their processing methods and correct them, before insisting upon having a complete mass production set-up, the machine tool industry will be able to supply their needs as fast as they arise, declared Tell Berna, general manager National Machine Tool Builders' Association. Unintelligent planning is causing some confusion and delay.

The big job before the machine tool industry, according to Mr. Berna, is to persuade customers to take deliveries consistent with their needs. He advised users to secure written

Dealers V-President

ALBERT M. STEDFAST

priorities instead of verbal ones covering their orders. The delivery date on an order with a preference rating is more important than the rating itself. The name "preference ratings" was chosen in Washington deliberately to emphasize the voluntary nature of the system of voluntary priorities.

The British are now preparing an orderly program and are in the process of working out priority ratings which dovetail into the U. S. defense program, stated Mr. Berna. Some production lines in England are 80 per cent completed, and need only that extra 20 per cent of machines to get going on munitions. Mr. Berna said that the machine tool industry would produce goods valued at more than $500,000,000 during 1941. He remarked that the demand for shell machinery had not been so great as the Ordnance Department had anticipated.

There is no government plan at present to commandeer machine tools on domestic order, pointed out Al-

Frederick B. Scott, Jr., Syracuse Supply Co., was elected president of the Associated Machine Tool Dealers at the annual meeting

bert M. Stedfast, Stedfast & Roulston, Inc., Boston, in his paper on the government's program. He stressed the fact that the National Defense Act of 1916 gives the President authority to enforce domestic priorities whenever necessary. That law has been reenacted as part of the Selective Service Act without regard to a state of war. Several thousand machine tools for which export licenses could not be obtained are still in New York warehouses, though authority to take them over was granted the government recently by Congress.

At the dinner Colonel H. A. Toulmin, Jr., speaking on "Organizing for War," advocated a separate Air Corps and a Coordinator of National Defense. In training apprentices, Monarch Machine Tool Co. uses the functional method of teaching, said D. H. McKellar, Monarch's supervisor of training. The principle of doing the job is taught rather than the operation of specific machines.

New machines must be created and produced to build the products which society will invent and demand 10 years hence, said A. G. Bryant, president Bryant Machinery & Engineering Co., Chicago, and past president of the association. Captain R. O. Brownfield, Wright Field, discussed the place of the Air Corps in national defense. E. B. Newill, assistant general manager, Frigidaire, made a talk on "Heat and Cold". John Sauer, Jr., Peninsular Machinery Co., Detroit, the retiring president, presided at all sessions.

New Officers are: President: F. B. Scott, Jr., Syracuse Supply Co., Syracuse, N. Y.; Vice-President: Albert M. Stedfast, Stedfast & Roulston, Inc., Boston, Mass.; Secretary-Treasurer: F. W. Schiefer, F. W. Schiefer Machinery Co., Rochester, N. Y.; Directors for 3 years: Edward A. Lynch, Edward A. Lynch Machinery Co., Philadelphia, Pa.; T. C. Stephens, Robert R. Stephens Machinery Co., St. Louis, Mo.; and A. G. Wigglesworth, A. G. Wigglesworth Machinery Co., Cambridge, Mass.

INSIDE DETROIT

Manufacture of aircraft parts is auto industry's No. 1 job; Knudsen places responsibility upon industry to see that its resources are utilized to best advantage in supplying aviation

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—W. S. Knudsen has a way of cutting straight to the heart of a problem and making other people like it. Until auto leaders attending the New York Auto Show heard Mr. Knudsen say at a luncheon that they had better "take another look," the general attitude had been that motor-car production was the industry's principal concern for 1941. Lack of standardization of plane designs gave rise to the convenient contention that manufacture of aircraft parts was not feasible in mass-production shops.

Mr. Knudsen followed up the attack that afternoon in closed session. Besides showing that two bomber designs are standardized, and other plane types may be, his remarks led to a complete reversal in attitude by his hearers. Now the industry sees aircraft parts as its "No. 1 job," and promises to do its utmost in putting all resources of skill, equipment and needed plant capacity behind the aircraft procurement program. It will have to do some fast stepping to prevent aviation motor output from running ahead of plane assemblies by the middle of 1941.

In attempting to continue the "American way," Mr. Knudsen has placed full responsibility upon the auto industry to see that its resources and those of its allied industries shall be utilized to the best advantage toward supplying the aviation industry, meanwhile maintaining car and truck production. The suspicion exists, however, in the minds of observers close to government that automobile production will have to take second place it the needs of aviation are not adequately met.

Co-ordination Necessary

In a recent meeting Mr. Knudsen further outlined his ideas to a committee representing the auto plants, parts plants and the tool and die industry. This committee was broadgage in its representation, and was not restricted to members of the three trade associations. The next step is for this committee to meet with one from the aviation industry. After an exchange of ideas, both sides can get down to working out the problems of what must be made and where it shall be made. The program is too large for a mere handing out of parts prints and letting everybody pick and choose as he sees fit.

While it is the intention to have this committee function in a democratic manner, there is little doubt that it must be able to exercise wide powers. To some extent the orders from Washington for eight billions of national-defense contracts have placed excessive loads upon certain companies and failed to draw other just-as-well-equipped concerns into the program. Some re-allocation of effort is indicated if all phases of the national defense program are to keep in step. Perhaps some decentralization in authority of the National Defense Commission itself will occur. Business leaders now in Washington may soon return home to take an active part in the national-defense programs of their industries.

Development Uncertain

Nobody can foretell accurately at this stage just how the aircraft parts program will develop. When the work is first assigned to auto, body and parts plants, it is likely that only individual parts or small sub-assemblies will be manufactured for shipment to the plane plants for assembly. Later on the exigencies of mass production may demand that larger sub-assemblies be produced by a principal sub-contractor, who may or may not be supplied by a number of parts makers. Entire wings are now being considered. The whole idea of the program is to make use of the skill and resources of the automobile industry without involving procurement of much equipment from the already overburdened machine tool industry.

Sheet metal parts for wings, controls and fuselages of airplanes are indicated as the principal contribution of the auto industry. But the tools, dies, fixtures and jigs and gages for these parts must be designed and made after contracts are awarded. While the complexity of the tooling may not reach that found in many automotive operations, those familiar with aircraft work say that several months will be required to design and make the tools after jobs are assigned by the committee and approved by the government. It is a fair assumption, therefore, that the actual "pieces" wanted by Mr. Knudsen can not commence to flow to plane plants much before next March at least, and perhaps not before summer.

PLAN NO CHANGE FOR AUTOS

DETROIT—In the interest of National Defense, the Automobile Manufacturers Association has gone on record against mechanical changes in 1942 models that will require purchase of equipment next Spring from hard-pressed machine tool industry. Some revisions in fender, front-end, trim and hardware can be expected in 1942 models. Their extent will depend upon conditions in the tool and die industry which will be busy next Spring on the aircraft-parts program. If the emergency continues for two or three years more, the automobile industry will undoubtedly spend huge sums for new equipment with which to bring their products mechanically up to date at that time.

Commercial aviation manufacturing facilities of Vultee Aircraft, Inc. will be concentrated in the Detroit area to be near suppliers of parts and local sources of skill and mass production manufacture. Two months ago Vultee acquired Stinson Aircraft Corp., which last year moved its commercial and newly developed military lines to a new plant at Nashville. Now the commercial business is being returned to the Wayne, Mich. plant.

Richard W. Millar, president, and Don I. Carroll, vice-president in charge of production for Vultee, told AMERICAN MACHINIST that re-opening of the Wayne plant marks the beginning of a long range program by Vultee to develop mass-production manufacture of commercial aviation as the mainstay of its business in the future. Production of the Stinson 105 will be stepped up to one hundred per month in the early part of next year, and the larger Reliant will be built in lesser quantities. A broad research and development program is underway to widen the scope of the commercial market served, particularly lower-priced pleasure craft.

The Wayne plant will be opened November 1, with six hundred to be employed by the year end. It is hoped to step up operations sufficiently next year to employ over two thousand. Twenty thousand square feet are being added initially to the Wayne plant. $500,000 will be spent, half for machinery. Barclay-Grow Corp., Detroit, maker of small planes, has been purchased and its personnel will form the nucleus of the Stinson Division's working force. Personnel of the Stinson Division will include Karl Kalpwasser, works manager; A. F. Fontaine, chief engineer, and R. E. Osborn, director of research.

The Nashville plant will be known as the Nashville Division of Vultee and is undergoing expansion.

Philip P. Gott Addresses Gear Manufacturers At Skytop Meeting; New Standards Adopted

SKYTOP, PA.—Trade associations can be of material help in promoting the program of national defense by cooperation between their technical committees and the military agencies, according to Philip P. Gott, of the Chamber of Commerce of the United States. Mr. Gott addressed the 23rd semi-annual meeting of the American Gear Manufacturers Association, held at Skytop, Pa., October 14-16. He pointed out that engineering specifications originating with the association would be found useful in the procurement of armament and other defense items.

Business and technical sessions during the three-day meeting were presided over by A.G.M.A. President U. Seth Eberhardt, Newark Gear Cutting Machine Co., and Vice-President Walter P. Schmitter, Falk Corporation.

The advantages of credit unions were stressed in an address by E. S. Sawtelle, Tool Steel Gear & Pinion Co. Mr. Sawtelle told of the progress the credit union plan had made in his concern and its advantages to the employee in need of financial assistance.

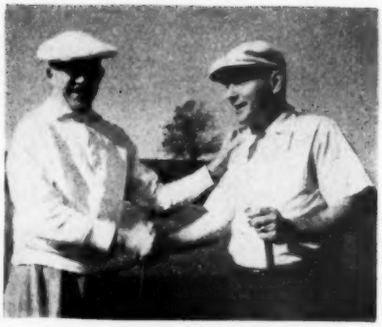
Bearing Selection Described

The problem of the gear drive designer in selecting from a wide variety of bearings was described by S. L. Crawshaw, Westinghouse Electric & Mfg. Co. This speaker outlined the characteristics of sleeve bearings and the various types of anti-friction bearings as applied to the commonly used gear drives. His talk was illustrated by views of installations that have a record of satisfactory performance.

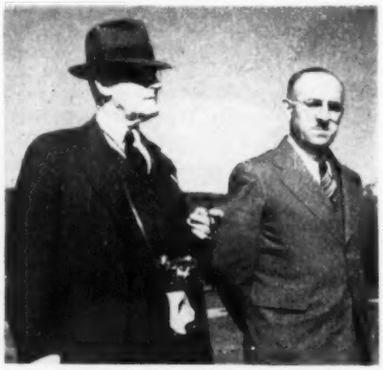
Motion characteristics of silent chains was the subject of a talk by H. A. McAninch, Link-Belt Co. Mr. McAninch told of the irrelevant motions in the operation of silent chains and how they could be minimized by the use of a generated tooth.

B. A. Miller, Cramp Brass & Iron Foundries Co., described the characteristics of two metals which he believed to have application in worm gearing. One of these, a copper-tin-nickel-zinc alloy, is subject to heat-treatment and age hardening to give desirable strength and ductility characteristics. The second, a copper-silicon-iron alloy, has an advantage in that it does not depend on imported materials.

This meeting of the A.G.M.A. witnessed marked progress in the work of the standardization committees coming under the general supervision of T. R. Rideout, Westinghouse Electric & Mfg. Co. The committee on the lubrication of gears of which H. A. McConville, General Electric Co., is chairman, offered a standard which was accepted as recommended practice. The committee headed by Granger Davenport, Gould & Eberhardt Co., completed its work on inspection tolerances of spur and helical gears which became a proposed recommended practice. J. H. Flagg, Watson-Flagg Co., chairman of the gearmotor committee, offered a proposed recommended practice on the ratings of concentric and parallel-shaft gearmotors.



Prof. F. Mickle, U. of Michigan, (left) and R. S. Marthens, AGMA treasurer, enjoy a moment of recreation at Skytop meeting



A. A. Ross, General Electric Co., (above, left) and L. D. Martin, Eastman Kodak Co., attended AGMA meeting, commented on papers. At right, D. T. Hamilton, Fellows Gear Shaper Co., finds time to take some candid pictures and stroll about the grounds

AGMA President, U. Seth Eberhardt, Newark Gear Cutting Machine Co., H. H. Kerr, Boston Gear Works, and F. B. Drake, Johnson Gear Co., (left to right) relax between sessions, makes plans for the future

Differences in Production Methods Discussed At A.S.M.E. Meeting on Shell Manufacture

CINCINNATI—Several hundred representatives of metal-working plants, U. S. Army ordnance officers, and representatives of the machine tool industry attended the A.S.M.E. meeting on manufacture of shell held here Oct. 16 and 17 under the auspices of the Army Ordnance Association, A. S. M.E. Ammunition Group, Machine Shop Practice and Metals Engineering Divisions and Cincinnati Section of A.S.M.E.

With Col. James L. Walsh, chairman, A.S.M.E. Committee on National Defense, presiding, the first session was given over to a discussion of shell steel specifications and furnace equipment suitable for heating shell billets for forging. This session was opened by Edward A. Muller, president, the King Machine Tool Co., and civilian chief of the Cincinnati Ordnance District. In his introductory remarks, Mr. Muller paid tribute to manufacturers in the metal-working industry who are showing much determination to supply needed products as rapidly as possible. He also complimented the Army Ordnance Department on the work that has been done in preparing specifications for needed material, particularly with respect to shell, which must be safe to handle, accurate in flight and efficient in fragmentation when it reaches the target. Because of the vast quantity of shell that would be required in the event of hostilities, the production problems involved probably are more important now than those involved in the manufacture of guns to fire these shell.

Ordnance shell steel specifications were discussed in some detail by Lt.-Col. Miles W. Kresge, Assistant to Chief of Ordnance, U. S. Army. He pointed out that shell is the product of essential compromises between requirements of the Army artillery divisions for shell that will function properly, and the requirements of steel suppliers, forgers, and metal-workers for a product which can be manufactured efficiently in large quantities. Free-machining, high sulphur, high manganese steels now are being used for shell so that the product can be machined rapidly and accurately. These steels will be used until a shortage of manganese forces a change in specifications. He also said that the Ordnance Department is open-minded on the subject of specifications, and will consider recommendations for changes where these will result in better manufacturing efficiency without reduction in quality of the product.

Interested listeners at all of the sessions were Sol Einstein, (left) vice-president, Cincinnati Milling Machine Co., and H. J. Wills, Carborundum Co. Mr. Wills read a paper on the classification of surface finish of shell at one of the morning meetings

James R. Weaver, Westinghouse, and Charles Meier, general manager of Acme Machine Tool Co., found time for a couple of stories while attending the A.S.T.E. meeting on shell production

The suitability of batch type, straight line continuous pusher type, and rotary hearth furnaces for heating shell billets were considered in an informative paper presented by Professor W. Trinks of Carnegie Institute of Technology. He pointed out that all three types of furnace are adaptable for this work, but that they each have certain limitations. In all three types it is necessary that the rate of heating and the maximum temperature be controlled carefully so that the edges and corners will not be melted to form slag on the house of the furnace. The furnace builders association has suggested a heating rate of 60 lb. per sq.ft. per hr. with a maximum furnace temperature of 2,300 F. for the heating of these billets. Control of furnace atmosphere to reduce scaling is important, but the formation of a slight amount of scale is to be expected in all three types of furnace. With regard to temperature and atmosphere controls, Prof. Trinks pointed out that automatic controls are worse than hand control when they are not supervised properly.

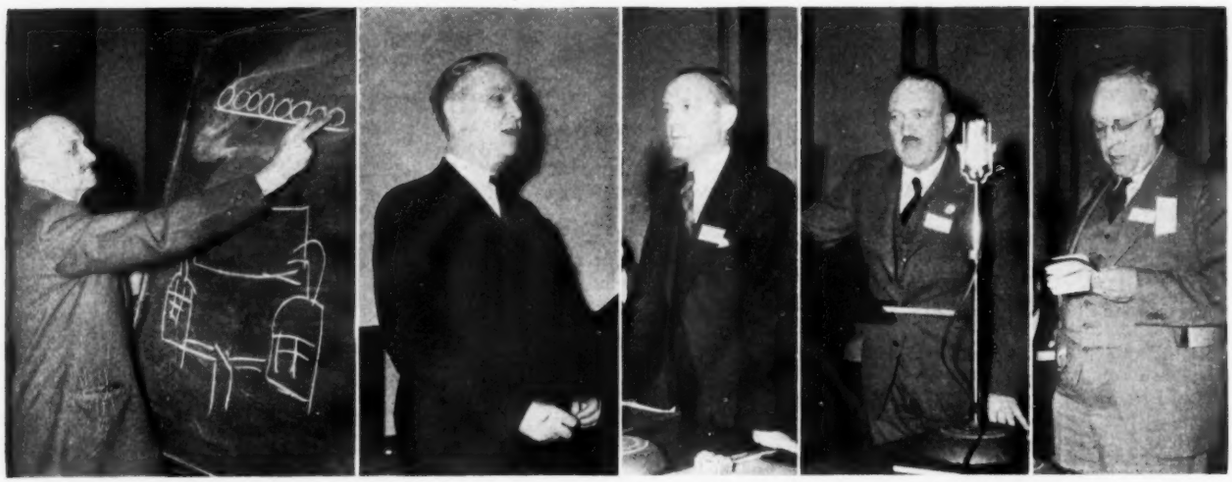
Edward A. Muller, (left) president, King Machine Tool Co., and chief of Cincinnati Ordnance District, was one of the first speakers. He is shown here with Warner Seely, Warner & Swasey Co.

In the discussion of Prof. Trinks' paper, Alan Dauch, George J. Hagan Company, pointed out that heating time in rotary hearth furnaces is about 60 per cent of that required in pusher type or batch type furnaces for the same work. Maintenance cost with rotary hearth furnaces is slightly higher than with other types, because it is a mechanical unit operating at high temperatures. This high maintenance cost, however, is offset by higher production rates. The discussion also brought out the fact that pusher type furnaces have a number of advantages, in that they are simple and economical to operate. Susceptibility to scaling and slag formation is highest in the rotary furnace and lowest in the batch type unit.

Efficient Arms Needed

In his talk at the luncheon Wednesday, J. B. Doan, president of the Cincinnati chapter of the Army Ordnance Association, and Chairman of the Board of the American Tool Works Company, pointed out that while trained men are necessary in modern warfare, they are not enough. We must have efficient arms in large quantities. He further stated that he believed that the hope of our democracy is to be so thoroughly prepared that statements of our leaders will not be taken as bluff, but will be backed up with a well-equipped, well-trained army.

The Wednesday afternoon session was given over to a discussion of shell forging equipment, with Robert T. Kent, production engineer, Ordnance Dept., U. S. Army, and George F. Schranz, general manager, Bald-



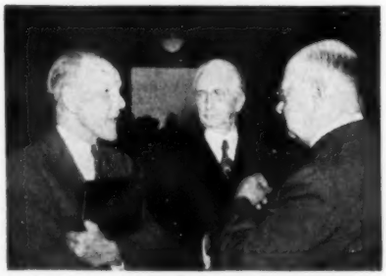
Active Participants—*Many A.S.M.E. members took active part in the discussion held during the meeting on the Manufacture of Shell. Above (left to right) Professor W. Trinks, Carnegie Institute of Technology, discusses the adaptability of various furnaces for heating shell billets. Lucien I. Yeomans talks on the application of shell machining equipment. Lt. Col. Miles W. Kresge, Ordnance Department, U. S. Army, spoke about ordnance shell steel specifications. Professor Frank Macconochie, University of Virginia, reported on a recent extensive survey of present day shell forging equipment. H. N. Anderson, The Hill Acme Co., took part in the discussion of shell forging methods. He recommended the use of special handling equipment to speed up forging of large shell by upset method*

win Southwark Div., Baldwin Locomotive Company, presiding. In his analysis of shell forging equipment, Frank Macconochie, professor of mechanical engineering, University of Virginia, pointed out that availability and speed of production are essentials in the shell program. Both the upsetting and the pierce and draw methods of producing shell forgings will be used, as well as a number of special shell forging machines which have been made available to American manufacturers. The relative merits of various types of equipment are not as important as the job of getting the shell program under way.

480 Shells Per Hour

Two new methods of forging shell were announced during this session. A. Waltman of Clearing Machine Corporation said that his company is building an automatic machine which should produce about 480 shell per hour, delivering them on a conveyor. This unit comprises a furnace and forging machine connected together, so that the only labor required is for loading the furnace. The first unit of this design will be ready for demonstration soon, according to Mr. Waltman. Also, in his paper on the flow of metal during the forging of shell, Mr. M. D. Stone, United Engineering and Foundry Company, announced development of a new hydraulic forging press by the Dominion Engineering Works of Canada, an associate of United Engineering and Foundry Company, which makes a complete shell forging in one operation. The second operation now done in a draw press is eliminated with this machine.

A shell machine capable of turning a shell a minute, designed for the Army by the machine tool industry was mentioned in his talk on cooperation between the government and the machine tool builder by Tell Berna, general manager of the Machine Tool Builders' Association, during the Thursday morning session. Mr. Berna announced that the Studebaker Corporation has built the first of these machines and has it in operation on a continuous life test. According to him, the reason for designing these machines is that in the event of war the army will have tested designs which could be followed by any manufacturer equipped for this type of production. This will insure a broad source of supply and enable the Army to get shell in large volume without expensive delay.



E. P. Blanchard, sales manager, Bullard Co.; J. B. Doan, chairman of the board, American Tool Works Co.; and August H. Tuechter, president, Cincinnati Bickford Tool Co., found mutual problems to talk over while at the meeting. Mr. Doan is president of the Cincinnati chapter, Army Ordnance Association

Stressing the part played by machine tools in National Defense, Mr. Berna stated that the industry already has doubled its output during the past twelve months, and probably will expand considerably during the next year. He pointed out that one of the major bottlenecks in defense production is the lack of trained men. To quote Mr. Berna, "Machine tools are only one element in national defense production, many other types of machinery are also needed. Plants need to be built, men need to be trained, large numbers of gages, jigs and fixtures will be required. Methods of manufacture must be checked and revised. And then all of these elements must be coordinated before large scale production actually gets under way. The machine tool industry is confident that it will be able to produce the machine tools required just as rapidly as plants will be ready for their installation and the men ready for their operation."

Simple Machines Advocated

Lucien I. Yeomans discussed the controversy between the two schools of shop procedure, in which one advocates the reduction of operations to their lowest terms and the use of simple machines, while the other advocates putting as many operations as possible upon one machine, with the requirement of a skilled operator not easily trained. He strongly advocated the use of simple machines for single operations, so that plants which will manufacture shell can get under way without first having to go through an extensive training period.

Japan Plans to Produce Needed Tools; U. S. Patentees Endangered

TOKYO—Plans to make Japan's engineering industries self sufficient in machine tools within three years were recently discussed at a government-sponsored conference. The result: machine tools which heretofore have been imported will be made in Japan. Officials hinted that if "encouragement" measures should fail to produce the desired results, the General National Mobilization Law will be invoked under which orders may be placed with manufacturers regardless of previous commitments. Private plants may be expropriated by the government as a last resort.

Government representatives indicate that foreign patents will be respected in the drive for Japanese manufacture of machine tools. However, patented machine tools which have not been imported or manufactured in Japan for three successive years may be compulsorily licensed under the Patent Law in Japan. This provision has much significance for American machine tool manufacturers whose designs are protected by Japanese patents. As long as manufacturers are able to export tools to Japan, infringement of patents is ruled out by law. However, if tools should become unavailable in Japan (as they have, due to American export restrictions) the American patentees are required to offer the patent for sale "on reasonable terms" so as to avoid invalidation or expropriation.

NAMES in the NEWS

James H. Chasmar, former works manager of the Remington Arms Co., Bridgeport, Conn., has been placed in charge of all work. Wm. C. Ashcroft succeeds Mr. Chasmar as works manager and A. E. Buchanan, Jr., technical director of the company, has been named assistant works manager.

Dr. Claude L. Clark, formerly of the department of engineering research of the University of Michigan, has joined the metallurgical staff of the steel and tube division of the Timken Roller Bearing Co. at Canton, Ohio as metallurgical development engineer. During the past ten years at the University of Michigan, Dr. Clark has conducted research studies of the properties of metals at elevated temperatures.

Rear Admiral Wm. G. DuBose, who has retired from the United States Navy after serving more than 45 years, including service as the Navy's chief constructor from 1937 to 1939, has been elected chairman of the executive committee and a director of Cramp Shipbuilding Co. In his new post, Admiral DuBose will take an active part in the reopening of the shipyard and in the construction of more than $100,000,000 of naval cruisers for which an order has been placed with the company.

Works Manager

D. C. PETERSON

New V-Presidents at G-E Supply Corp.

R. J. BROWN

C. R. PRITCHARD

Charles R. Pritchard and Ralph J. Brown have been appointed vice-presidents of the General Electric Supply Corp., Bridgeport, Conn.

D. C. Peterson, formerly vice-president in charge of manufacture of the Buda Co., has been appointed works manager of the Superior Engine Division of the National Supply Co., Toledo, Ohio. In 1934 he was affiliated with the Continental Can Co., New York, N. Y.

Captain S. C. McDowell, U. S. Navy, retired, was appointed new president and general manager of the Enterprise Foundry Co., San Francisco. Charles Hoehn, who had been president of the concern, was named chairman of the board.

Oliver T. Osborne, former general manager of the Locke Steel Chain Co., Bridgeport, Conn., has been elected president. Mr. Osborne has been with the company 28 years and succeeds D. Walter Haggerty, who becomes chairman of the board. Other newly elected officers include: Sylvanus D. Locke, vice-president and treasurer; F. S. McDaniel, secretary.

Eugene R. Perry has been promoted to manager of engineering and superintendent of the Micarta works of the Westinghouse Electric & Mfg. Co. at Trafford, Pa. Mr. Perry has been associated with Westinghouse since 1929.

E. W. Ritter, former general manager of radio tube manufacturing, has been appointed vice-president in charge of all manufacturing and production engineering of the RCA Mfg. Co. H. L. Sommerer, former manager of manufacturing has been appointed assistant to Mr. Ritter.

PLANT EXPANSION

American Steel and Wire Co., Worcester, Mass., subsidiary of United States Steel Corp., will construct four additions to the company's South Works. The project, to be completed within 20 months, will provide modern, centralized facilities capable of meeting the needs of the New England market.

Boeing Airplane Co. will expand its plants at Seattle, Wash., and Wichita, Kan., to a total of 74 acres, five times their area of a year ago. Of the 1,600,000 sq. ft. to be added, two-thirds will be at Seattle and one-third at Wichita.

General Electric Co. has begun a $50,000,000 expansion program to supply National Defense needs. All plants, equipment, and defense materials will be increased.

R. Hoe & Co., Inc., New York, N. Y. will erect a new $40,000 welding plant for the manufacture of recoils for guns and gun parts. The new plant will increase the total manufacturing area of the company to approximately 190,000 sq. ft.

Martin Electric Co., Detroit, manufacturers of resistance welding transformers, is completing an addition to its plant. The expansion doubles the manufacturing floor space and will add more than 100 per cent to production capacity of the company.

Carboloy Co., Inc., Detroit, is opening a branch office in Los Angeles, and will carry a complete stock of

Cited—*George H. Bucher, president, Westinghouse Electric & Mfg. Co., (left) receives a 30-year service emblem, presented by A. W. Robertson, chairman of the Co. More than 21,000 other employes, who have been with the Co. 10 or more years, received similar service awards.*

standard carboloy tools. The offices will be in charge of J. W. Doody and Ray D. Mack.

American Magnesium Corp., New York, N. Y. is tripling its fabricated magnesium output to supply the demands of National Defense. A new die-casting plant has just been erected and equipped at Garwood, N. J.

Bendix Aviation Corp., Bendix, N. J., has purchased the Atwater Kent Mfg. Company's plant No. 6 at Philadelphia. After details of the purchase have been approved, the plant will be prepared for operation, and it is expected that between 7,000 and 10,000 men will be employed.

Bell Aircraft Corporation's new $1,050,000 aircraft assembly plant at Niagara Falls, N. Y. is scheduled to be completed by Feb. 1941.

The new building will provide approximately 300,000 sq. ft. of floor space. A force estimated at 3,000 men, employed on three 8-hour shifts, will assemble Airacobra type fighting planes for the United States Army.

Aluminum Co. of America will erect a large addition to its Edgewater, N. J. plant. The new factory will be 8 stories in height and will measure 141 by 81 ft. This project is part of the company's $150,000,000 expansion program.

Westinghouse Electric & Mfg. Co. will spend $500,000 in expanding facilities of its lighting divisions at Cleveland, Ohio. The expansion involves four new buildings and operating equipment, and is scheduled to be completed February 1.

BUSINESS ITEMS

National Cylinder Gas Co., Chicago, Ill., will take over the distribution of the "Rego" line of gas welding and cutting equipment manufactured by Bastian-Blessing, also of Chicago.

Kitson Co., Philadelphia, Pa., has acquired the exclusive rights for the manufacture and distribution of Oman belt-lubricating bearing metal. Since the Kitson Co. was founded, in 1893, it has specialized in the manufacture of brass goods for the water, gas, and plumbing industry.

Willard Equipment, Ltd., Vancouver, B. C., has been appointed representative in British Columbia and Alberta for the Mercury Mfg. Co., Chicago, Ill., a leading manufacturer of materials handling equipment.

H. A. Smith Machinery Co., Syracuse, N. Y., has been appointed a distributor for Sullivan Machinery Co., Michigan City, Ind. The Sullivan line of air and gas compressors for industrial uses will be distributed.

OBITUARIES

Benedict Shubart, western sales representative, Link-Belt Co., Chicago, died recently at the age of 64.

Arthur W. Graham, president and treasurer of the Graham Mfg. Co., Providence, R. I., recently died of a heart attack at the age of 67. At one time Mr. Graham was connected with the American Locomotive Co. and later with the Builders Iron Foundry.

Ralph R. Hull, 61, former secretary-treasurer of the Houde Engineering Corp., and one-time head of the construction department of the Lackawanna Steel Co., died recently at his home in Buffalo after an illness of several months.

Morrison Mills, eastern district manager of the Construction Equipment Div. of the Chain Belt Co., Milwaukee, died recently. Mr. Mills was Service Manager of the Construction Equipment Div. of the company from 1931 to 1937.

Carl Wentorf, plant superintendent of the West Bend Aluminum Co., West Bend, Wis., died recently at the age of 67. Mr. Wentorf helped found the West Bend firm 29 years ago.

H. H. Timken, Sr., co-founder of the Timken Roller Bearing Co., Canton, Ohio, died of pneumonia two

Dies at 72

H. H. TIMKEN, SR.

weeks ago after a short illness. Mr. Timken, who was 72 years old, was chairman of the board at the time of his death. With his father and brother in 1898, Mr. Timken helped found the company. He has watched the organization grow from one plant to plants in Canton, Columbus, Wooster and Mount Vernon, all in Ohio, and in which more than 10,000 persons are employed. Mr. Timken was president of the company for 23 years and chairman for 12. His father developed the Timken Roller bearing, which has played a major role in the development of the automobile.

Noble J. Ross, one of the founders of the Beloit Iron Works in 1885, is dead at the age of 86. At the time of his retirement 15 years ago, Mr. Ross was vice-president of the iron works.

MEETINGS

American Management Association. Annual conference. Cleveland Hotel, Cleveland, Ohio, Nov. 12 and 13.

American Society of Mechanical Engineers. Annual convention. New York, N. Y., Dec. 2–5.

National Exposition of Power and Mechanical Engineering. Grand Central Palace, New York, N. Y. Dec. 2–5.

Society of Automotive Engineers. Annual meeting, and engineering display. Book-Cadillac Hotel, Detroit, Mich., Jan. 6–10, 1941.

Society of Automotive Engineers. National Fuels and Lubricants meeting. Hotel Mayo, Tulsa, Okla. Nov. 7–8.

Motor & Equipment Manufacturers Association. Annual meeting. Blackstone Hotel, Chicago, Ill. Dec. 10.

SHOP EQUIPMENT NEWS

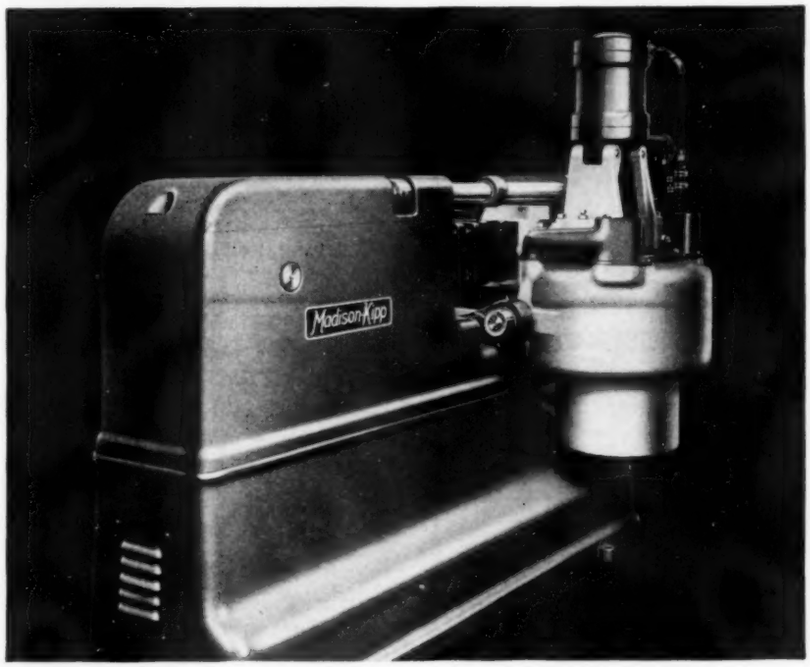
"Kippcaster" Die-Casting Machine Designed for Handling Zinc Alloys

Madison-Kipp Corp., Madison, Wis., has developed the Model No. 500 "Giant Kippcaster" especially for the die-casting of zinc alloys. This new model is about twice as large as the company's previous standard model, with a weight of about four times that of the standard to provide added strength needed for handling substantially larger parts.

The new model "Kippcaster" utilizes a combination of hydraulic and air operation. Die-head rams operate hydraulically through a special toggle arrangement, which is actuated by a hydraulic cylinder. The standard hydraulic system is a Vickers combination pump driven by a 1½ hp. 1,200 r.p.m. motor. Standard die head measures 8 x 10 in., but clearance is provided so that larger dies can be used. Both stationary and movable dies may be of two standard thicknesses—either 3 or 4 in.

Machine stroke is 8½ in. with standard cylinders and plungers. Over 1,800 lb. pressure is exerted on the metal with 100 lb. air pressure. Gooseneck with standard plunger has a capacity for shooting a 3½ lb. casting. Pot capacity is 200 lb. of zinc alloy.

Main castings of the machine are made of high strength Meehanite A iron, as are the metal pot and gooseneck. Power parts are made of heavy cast steel. Length of the machine is 8 ft. 1 in., width is 3 ft. 8 in., and height is 6 ft. 2 in. Weight is approximately 6,500 lb.



Chip-Breaker Grinder Announced by Carboloy

A low-priced grinder for grinding chip-breakers in carbide tools has been announced by Carboloy Co., 11149 E. Eight Mile Rd., Detroit, Mich. With this grinder, exact forms of chip-breakers determined as ideal for any given operation can be duplicated quickly when the tool is re-ground. The tool is clamped in a toolholder mounted on a universally adjustable fixture table fitted with three protractors, to permit adjusting to correct setting in all directions with minimum effort.

The tool is then moved under the wheel to a distance corresponding to the chip-breaker width and the wheel is fed down while feeding the table back and forth. The wheel-feed is also provided with graduations so that chip-breakers can be ground to exact depth. Resinoid diamond wheels of 100 grit are recommended. Grinder

is designed for use with tools up to 1¼ in. wide. Operation is through a 110 volt, 60 cycle, ¼-hp. ball-bearing motor equipped with reversing switch.

Towmotor Lift Truck Handles 3,000-Lb. Load

Towmotor Co., 1264 E. 152nd St., Cleveland, Ohio, has developed a small lift truck especially for handling 1,000- to 3,000-lb. loads. Built on a 40-in. wheelbase, this Model No. LT-40 truck weighs in the neighborhood of 3,500 lb., has a turning radius of 68 in., an over-all lift of 35 in., and a length without forks of 70 in. Interchangeable attachments — forks, rams, scoops, flat plates, special loading devices—fit the unit for a wide variety of materials-handling operations.

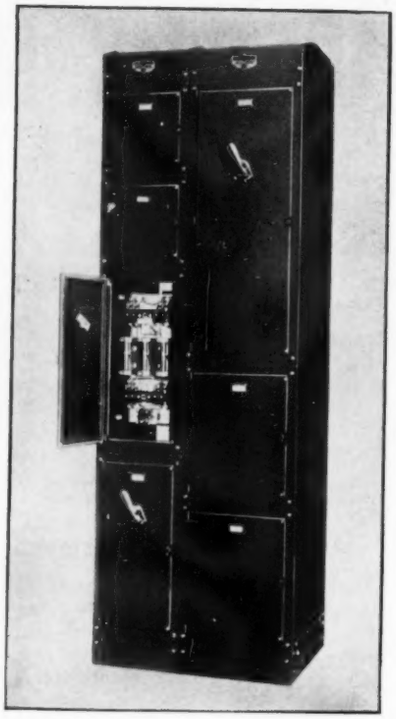
Powered by a 22-hp. four-cylinder gas engine, equipped with degasser and governor, the truck travels at

speeds from 1 to 10 m.p.h. Two speeds forward and two in reverse are achieved by a special transmission having only four gear elements. A special hydraulic lifting and tilting system enables the unit to lift and stack its rated load accurately to heights of 7, 9 and 11 ft. at approximately 40 ft. per min. Design improvements include entire motor assembly and battery instantly accessible by lifting driver's seat; specially designed transmission case which permits removal of air-ventilated clutch plate without disturbing transmission; front (driving) axle housing designed as an integral part of the frame structure.

Cutler-Hammer "Unitrol" Permits Flexible Installation

The "Unitrol" system of sectionalized motor control developed by Cutler-Hammer, Inc., 205 N. 12th St., Milwaukee, Wis., permits all needed types of control devices to be organized in locker-like motor control centers instead of the usual pillar-and-post method of mounting. Standardized construction allows quick building up of any control center to meet present requirements. Future changes are quickly and easily made by adding or removing sections, or by replacing unit controllers.

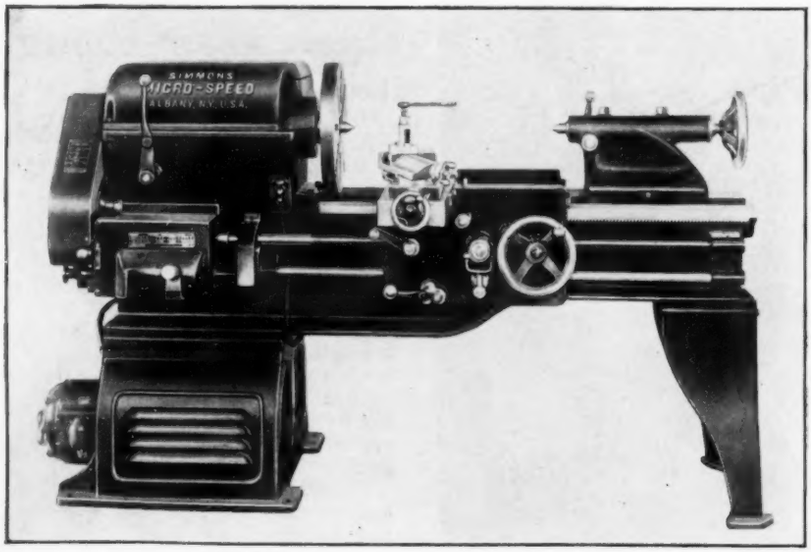
Standard motor control units are mounted in standardized cubicle sections which are made in 32 sizes,



8 widths and 4 heights for mounting any combination of units. Standard units can accommodate controllers, disconnect switches and accessories as required. Control units can be mounted in both front and rear of the section, giving double-sided construction.

"Micro-Speed" Drive of Simmons Gap Bed Lathe Changes Spindle Speed Without Gears or Clutches

Maximum flexibility of spindle speeds without gears or clutches is achieved through the use of the "Micro-Speed" drive on a new line of gap bed lathes developed by Simmons Machine Tool Corp., Albany, N. Y. This drive, installed in the cabinet type leg, provides a virtually unlimited variation of spindle speeds by finger-tip control. Only a slight twist of the hand-wheel on the headstock gives a wide range of speeds. Change is instantaneous.

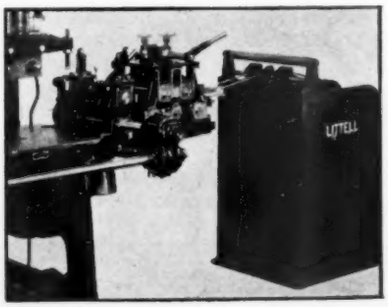


Removable gap blocks in the bed permit greater swing through the gap. The lathe is equipped with Timken precision tapered roller bearings on the main spindle, which is driven through V-belts. Rigid bed is of semi-steel. Carriage is so arranged to bring the compound rest close to the face plate. All gears in every feed mechanism are of forged steel, with accurately cut teeth. To preserve accuracy in screw cutting, a separate feed rod is provided.

This lathe is built in 16–25 in. and 18–27 in. sizes. Specifications, respectively: swing over ways, 18 and 19 in.; swing through gap, 25½ and 27¼ in.; total width of gap, 14 and 14 in.; width of each gap block, 7 in.; swing over carriage, 12 and 13 in.; distance between centers on 6-ft. bed, 36 and 36 in.; weight, 3,500 and 3,700 lb.

Intermittent Scrap Cutter Also Trims Finished Parts

Punch press scrap can be cut to predetermined lengths and finished products cut to length with the dual purpose intermittent scrap cutter developed by F. J. Littell Machine Co., 4169 Ravenswood Ave., Chicago, Ill. This cutter operates at any given



number of strokes of the press. In normal operating position the cutter blades are held open by spring. A gag or blocker unit is built into the rear scrap-cutter connection, operated by a solenoid which moves the gag to the cutting position. Solenoid is connected to the controlling unit which consists of a ratchet (which may have any number of teeth), a driving mechanism for operating the ratchet at one or more teeth per stroke of the press, and a switch operated by trip lugs on the ratchet gear. In operation the lugs trip the switch every so many strokes of the press.

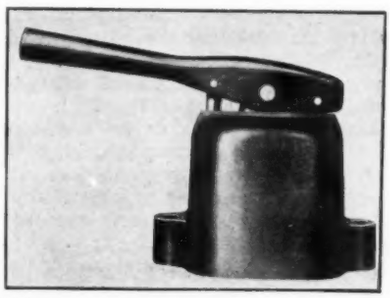
"Coolflo" Coolant Pump Features Compact Design

Warren Steam Pump Co., Warren, Mass., has developed the "Coolflo" coolant pump especially for machine

tool application. Both submerged and outside mounting types are made.

Unit is extremely compact, and will circulate coolant containing dirt, chips and abrasives with minimum wear and without clogging. Casing

and suction head are made of high-grade cast iron. Hard bronze impeller is of the open type, hydraulically balanced. One-piece shaft is of heavy stainless steel. A totally inclosed 220, 440 or 550 volt motor is built into the unit.



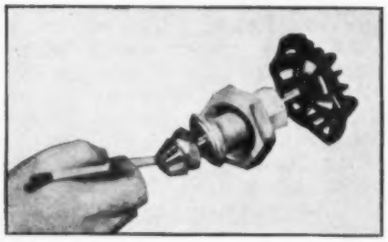
Four Way Valve Controls Two Double-Acting Cylinders

C. B. Hunt & Son, 1851 E. Pershing St., Salem, Ohio, has developed a double four-way hand-operated air valve suitable for controlling two individual double-acting air cylinders. This valve is said to be suitable for control of air-operated clamps, fixtures, knives and other devices where it is necessary to have one point of control for two cylinders that lead and lag one another in their respective actions.

Hobbing-Time Calculator Offered by Barber-Colman

A slide rule designed to simplify the calculation of hobbing time offered by Barber-Colman Co., Rockford, Ill., permits calculation of hob approach for spur gears, spline shafts and other straight forms. Hobbing time is easily calculated by setting the two slides

on the reverse side in the order indicated. The rule contains all standard hob speeds found on Barber-Colman machines. By interpolation the calculator can also be used for determining hobbing time on other makes of machines.



Hancock Valve Parts Now Are Superfinished

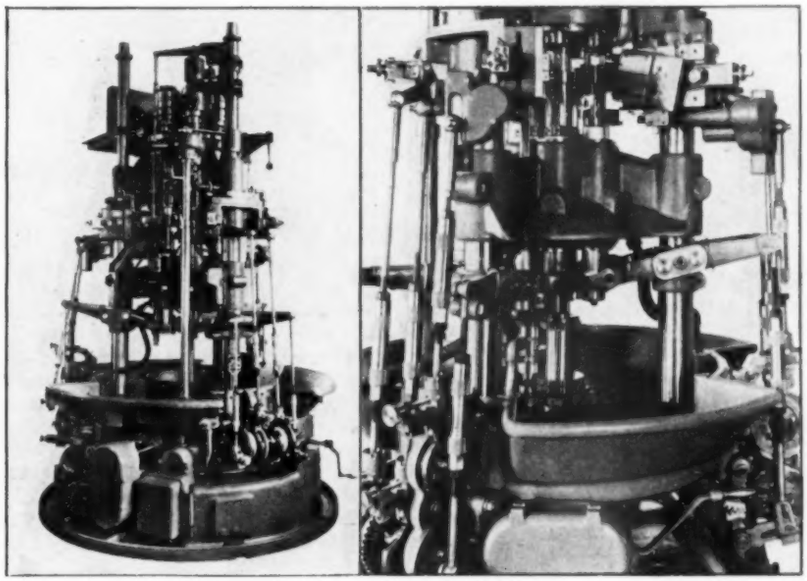
Life of valve seats and disks is claimed to be increased twelve-fold by the use of superfinishing on the "500 Brinell" line of valves offered by Hancock Valve Div. of Manning, Maxwell & Moore, Inc., Bridgeport, Conn. Specially developed superfinishing machines are used for the newly adopted process.

"Gyromatic" Vertical Automatic Screw Machine Requires Minimum Floor Space for Installation

Built by Tavannes Machine Co. of Switzerland and distributed in the United States by Cosa Oversea Trading Corp., 5000-4 Chrysler Bldg., New York, N. Y., the "Gyromatic" vertical automatic screw machine occupies only a fraction of the floor space needed by conventional horizontal types. Other advantages accruing from the vertical design are claimed to include reduction of noise, virtual elimination of vibration, greater convenience and increased safety.

Feed cams of the six longitudinal and six cross slides are located around the base, so that diameters and lengths of parts can be adjusted to within 0.001 in. while the machine is in operation. All slides are simple toolposts taking usual turret lathe tools. They are actuated by easily interchangeable independent cams. Each cam can be used for many strokes through a system of levers. The six boring, tapping and reaming spindles coming from below opposite the work spindles allow chips to drop out of holes, making deep-hole drilling easier. Design permits constant checking of all tooling through plastic windows in the machine enclosure, not shown in the illustration.

Adjustable stops control down feed of bars. Spindle turret revolves on ball and thrust bearings, and is locked on a diameter twice as large as the spindle circle diameter. No chips, cutting oil or dirt can fall on

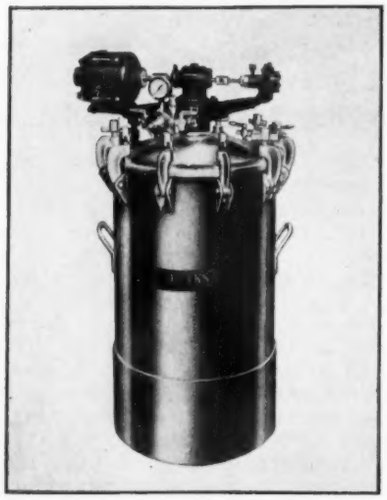


the spindle head, which is high above the cutting tools.

All three current models of the "Gyromatic" have six spindles. Capacities for bar work are 1, 1⅝ and 2¼ in.; for chuck work, 4, 5½ and 7½ in. If soft metals are to be machined, larger sizes can be chucked. Either air or mechanically operated chucks can be used. All machines have individual drive from a single motor.

Binks Circulating Pump Serves as Agitator

Binks Mfg. Co., 3114-36 Carroll Ave., Chicago, Ill., is offering the No. 460 series combination agitator and circulating pump units for use in spray finishing work. Perfected for large automotive plants, these units are now available to all industries where



a small paint circulating system is desired. The unit is adaptable to all Binks Type TU tanks, and is said to be suitable for multiple spray gun operation, and for short pipe runs. It can be mounted on the tank as shown or can be mounted above the tank and driven by a flexible shaft. Either air or electric motors can be used to furnish the driving power.

Aluminum Rivet Heater Developed by A.C.F.

The "a.c.f." Berwick electric aluminum rivet heater offered by American Car & Foundry Co., 30 Church St., New York, N. Y., has 12 slots on each side of the heater so that 24 rivets can be heated at once. Rivet diameters run from ⅛ to 1⅛ in. Length of heat depends upon rivet length, which can be up to 4 in.

This heater is equipped with fully automatic temperature control, so that any temperature between zero and 1,000 F. can be obtained. Within 3 min., 24 rivets of practically any size can be heated to 400 F.; if it is desired to heat them to 950 F. it will take approximately 4 min. Heater can be used for annealing, or for heating rivets to drive hot. Likewise it is feasible to use the heater for heating aluminum rods for making a rivet-head, bolt-head or forging. Heater rating is approximately 15 kva. and

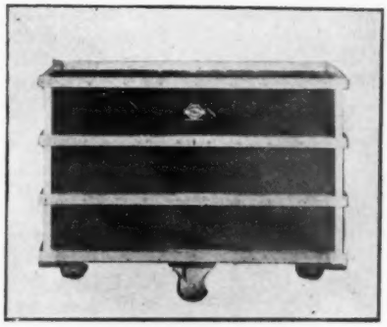
it can be built for any a.c. voltage. There are two ranges of speed: one high, to get the heater hot, and the other low, to keep it heating.

"Mercotrol" Pressure Switch Has 10-70 Pound Range

The Model No. 15-45 "Mercotrol" mercury contact pressure switch, developed by Center & Giveen Co., 2024 University Ave., Berkeley, Calif., has a cut-in pressure range of 10-40 lb., and a cut-out pressure range of 20-70 lb. Pressure differential between cut-in and cut-out can be varied from 10 to 60 lb.

Said to be ideally suited for small

pressure systems, this switch is designed for service on non-corrosive liquids or gases. Mercury tubes are securely inclosed in a steel shell covered with Bakelite. A quick tripping action is imparted to the tube by a patented snap-action feature, eliminating chattering. Complete unit is claimed to be positively moisture, insect and dust proof.



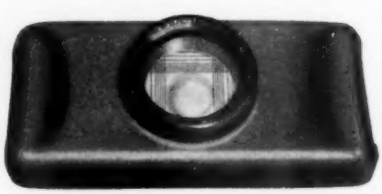
Spaulding Fibre Truck Features Ease of Handling

The Style A factory truck offered by Spaulding Fibre Co., 484 Broome St., New York, N. Y., is claimed to combine long wearing quality, light weight and convenience of handling. Body is of vulcanized fibre, while the bottom is of wood, with hard-wood cleats to which casters are attached. Casters are 4 or 4½ in. in diameter, and can be furnished with iron, fibre or rubber-tired wheels. Bands are made of oak reinforced with steel angles and corners. Trucks can be made to any dimensions desired.

Fell Precision Level Needs Only One Setting

Only one setting of the level is required when leveling machine tools or other equipment with the all-way precision level offered by Wm. B. Fell Co., 700 South St., Rockford, Ill. This level, easily read to 0.00025 in., also shows 0.0005 in. per ft. With this extreme range the device can also be used for accurate checking of straightness on work that does not need to be level, and as a time saver for leveling where extreme accuracy is not needed.

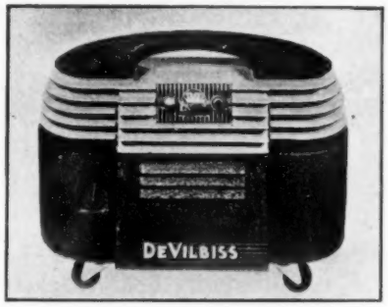
Heavy sections are employed in the level to avoid possible temperature distortion. Graduations are in 0.0005 in. per ft., and form squares about a circular bubble, thus giving coordinate readings. Graduations are on the side of the glass toward the



bubble. This allows the use of heavy ½-in. thick glass. Base is made of heat-treated cast iron, lapped flat by optical methods. Glass assembly is mounted solidly in a spherical surface which is an integral part of the base casting. Four thumb screws under the cap permit adjustment.

DeVilbiss Portable Unit Has High Efficiency

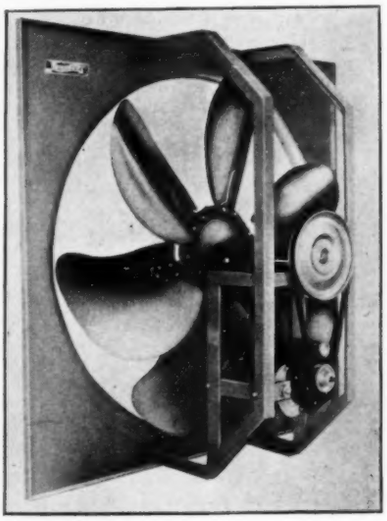
The Type NKB portable air compressor for operating small paint spraying equipment, developed by the DeVilbiss Co., Toledo, Ohio, is claimed to have an efficiency high enough to enable it to do the work of considerably larger units. Rated at ½-hp., it is the successor to the company's former Type NK outfit, and is the companion piece to the ¼-hp. com-



pressor introduced recently. Weighing only 72 lb., the unit is readily portable. Actual delivery is 4.55 cu. ft. per min. at 45 lb. pressure. It is claimed to be suitable both for interior and exterior painting in factories and for production work.

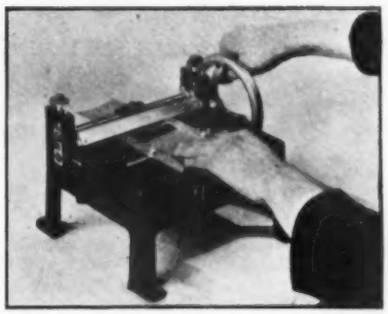
Chelsea Exhaust Fan Mounts in Roof or Wall

The Type IND industrial belt-drive exhaust fan made by Chelsea Fan & Blower Co., 370 W. 15th St., New York, N. Y., can be installed either in a wall or in a compact penthouse unit which fits a level opening in the roof. Fan is belt-driven to reduce motor cost and save power consumption. A protruding orifice permits greater air delivery, while a heavy-duty die-stamped blade assures precision balance. Ball bearing motors and rugged all-steel construction make for durability. Capacities range from 7,000 to 30,000 cu.ft. of free air per min., with motors ranging from 1/3 to 1½ hp. Shipping weight is 115 to 410 lb.



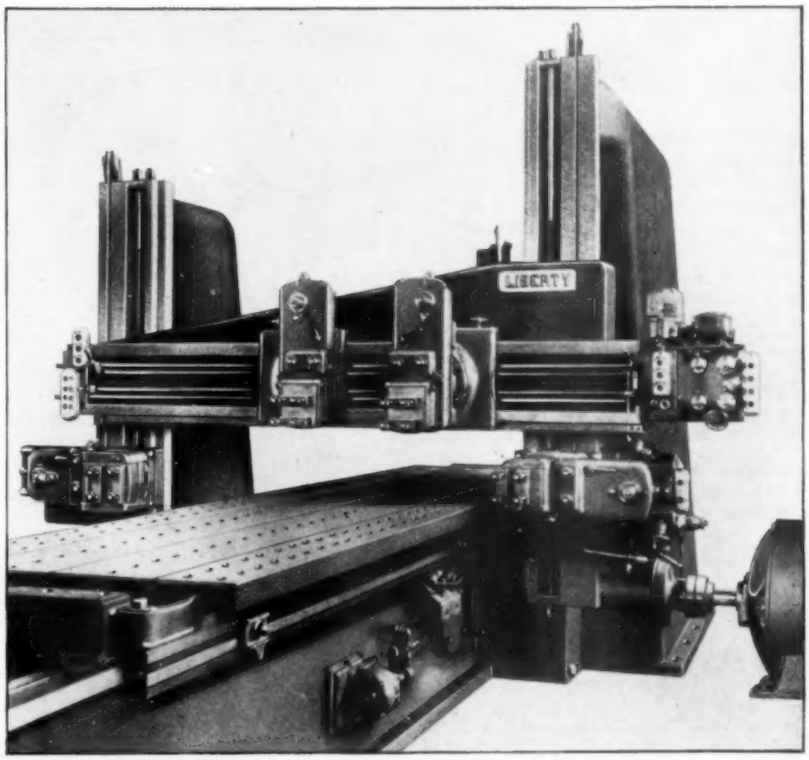
"Ideal" Insulation Former Makes Uniform Slot Linings

Neat, uniform slot linings can be easily made with the insulation former offered by Ideal Commutator Dresser Co., 1057 Park Ave., Sycamore, Ill. Either plain or cuffed insulation of any length up to 8 in. wide may be handled. Machine operates by turning a hand crank while insulation is guided between a rubber roller and two creasing rollers



by aluminum brackets. The rubber roller protects insulation and prevents the creasing roller from cutting through. Any desired width of trough up to 1½ in. may be obtained by adjusting the span between the two hardened steel creasing rollers.

Heavy-Duty Movable-Housing Planer Developed by Liberty Machine Tool



Liberty Machine Tool Co., 1050 Weller Ave., Hamilton, Ohio has developed a heavy-duty convertible planer with a movable, motorized left-hand housing. Maximum distance between the housings is 73 in., with a minimum distance of 42 in. Rail heads are offset towards the center and side heads are offset towards the top, with all heads and tool slides having power rapid traverse and power feed in all directions.

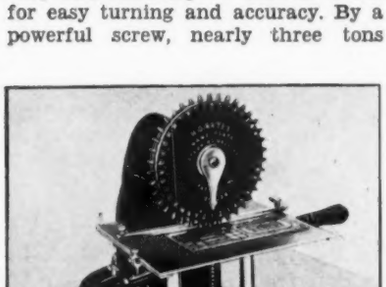
Housings are of heavy construction, with extremely wide faces. All screws are stationary with revolving nuts operating on thrust bearings. Table is of the flanged boxed type with full length clamps on both sides which are lubricated by felt wicks. Bed is of the inclosed type, with a flange on the bottom for fastening to the foundation. It is provided with a double wall through the gearing section. Forced feed lubrication is used.

The machine has electrically operated mechanical friction feed throughout to all heads, allowing the rail and each side head to be independent units with separate motors for each unit. Side heads have counter-weights which are suspended inside the housings. There is nothing below

the floor line of the machine, with only counterweight support brackets on top of the machine. Table speeds are available to suit requirements.

Bates Stamping Machine Marks Plates or Parts

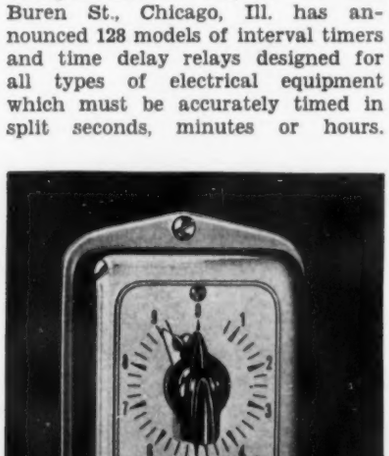
The No. 5 name-plate stamping machine offered by H. O. Bates, 245 N. Broad St., Elizabeth, N. J., stamps name-plates, parts or pieces ranging from 0.005 in. to 3¼ in. thick, and up to 9 x 7½ in. in length and width. Machine has a double row heavy-duty SKF bearing in the die wheel for easy turning and accuracy. By a powerful screw, nearly three tons



pressure can be applied which permits stamping stainless steel and other high-strength alloys. Depth of impressions can be easily controlled for stamping soft materials. Standard machine is available with dies ranging from $\frac{3}{32}$ to $\frac{5}{8}$ in. Extra die wheels can be furnished, and special characters can be substituted.

Paragon Electric Timers Have Wide Interval Range

Paragon Electric Co., 37 W. Van Buren St., Chicago, Ill. has announced 128 models of interval timers and time delay relays designed for all types of electrical equipment which must be accurately timed in split seconds, minutes or hours.



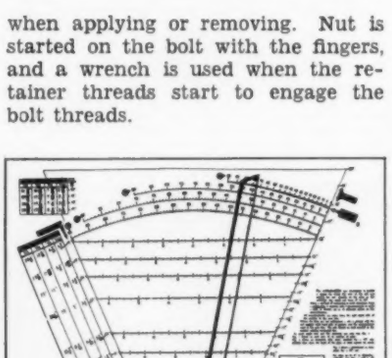
Powered by slow-speed, self-starting synchronous motors, these all electric controls are equipped with fast acting, silver contact micro switches. Manual or automatic reset models for built-in flush panel mounting, inclosed surface mounting or wall mounting are available.

"Security" Lock Nut Uses Elliptical Spring Retainer

A lock nut which is claimed to permit tightening up or backing off years after application without loosening its grip has been developed by Security Metal Products, Inc., 362 E. Kalamazoo Ave., Kalamazoo, Mich. Known as the "Security" lock nut, this device utilizes a slightly elliptical spring-steel retainer permanently seated in the head of a standard nut.

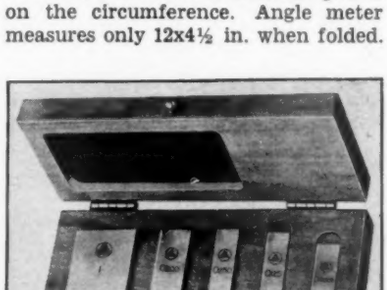
When the nut is applied, the retainer is distorted from an elliptical into a circular shape, thus setting up a powerful spring pressure between the bolt threads and the retainer threads. Neither the bolt threads nor the retainer is injured

when applying or removing. Nut is started on the bolt with the fingers, and a wrench is used when the retainer threads start to engage the bolt threads.



"Wolfe" Angle Meter Aids Cutting Pipe Joints

Distributed by Interstate Sales Co., 1123 Broadway, New York, N. Y., the "Wolfe" angle meter is said to save considerable time in marking pipes for cutting at odd angles. Adaptable to any angle from 0 to 90 deg. in steps of 1 deg., on diameters from 1 to 20 in., this device enables the pipe to be marked directly without calculations of any kind. Using a method of measuring in both directions from the center line, it requires only four measurements to mark a pipe or stretch out in sixteen different points on the circumference. Angle meter measures only 12x4½ in. when folded.



"Mechanic's Own" Gage Blocks Offered by George Scherr

George Scherr Co., 128 Lafayette St., New York, N. Y., has added the "Mechanic's Own" set to its line of "Ultra-Chex" precision gage blocks. Designed as a unit for the toolmaker's and mechanic's tool box, this five-block set enables a machinist to produce a part to within extremely accurate limits.

The set consists of gage blocks accurate to within 8 millionths of an inch in the following lengths: 1.0000, 0.5000, 0.2500, 0.1250, and 0.0625 in.

TelAutograph "Telescriber" Transmits Messages, Sketches

An improved "Telescriber" for instantaneously transmitting written messages and sketches over wires has been announced by TelAutograph Corp., 16 W. 61st St., New York, N. Y. This instrument transmits writing, sketches or designs in facsimile to a number of stations simultaneously or to any one or more stations selectively, within one building or between buildings miles apart.

Machine measures only 12½ in.

In vertical Milling Machines also, rigidity originates in the column — the backbone of the machine—and determines the productive capacity of the machine more than any one other factor.

Note how carefully the column of a Milwaukee Vertical Milling Machine has been engineered for the proper distribution of metal — an inside horizontal wall divides it into a double box section, the cross mounting of the motor permits a solid rear wall, which, together with the solid front face, assures an unusually rigid structure.

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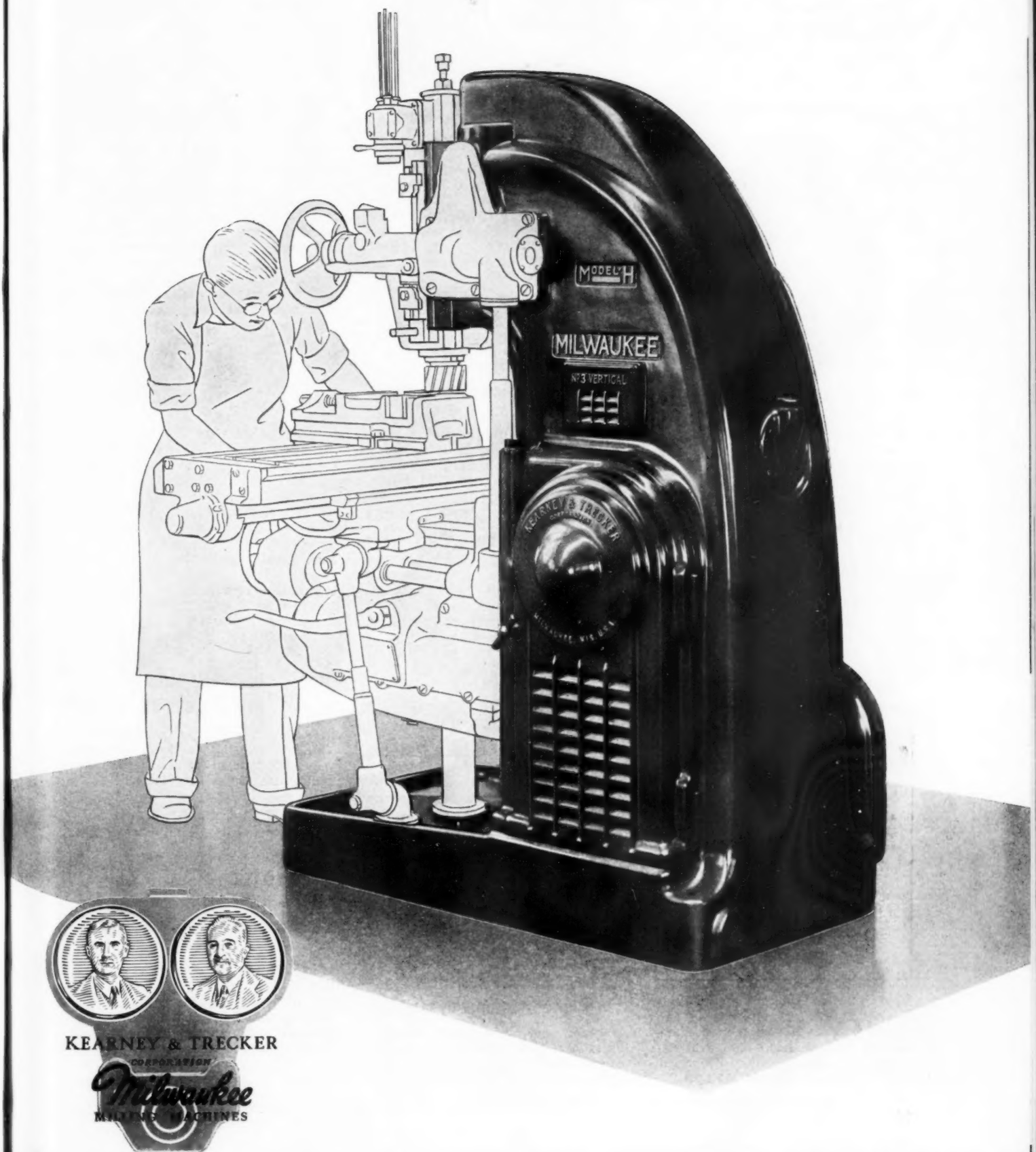

KEARNEY & TRECKER
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MILLING MACHINES

MILWAUKEE MILLING MACHINES

wide, 18¾ in. deep and 10⅝ in. high. It operates on alternating current. Units are available which both send and receive, while others receive only.

"Sealmaster" Hanger Bearings Designed for Screw Conveyors

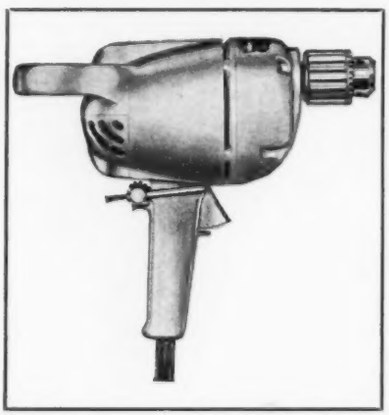
Stephens-Adamson Mfg. Co., Aurora, Ill., has developed a line of "Sealmaster" ball bearing hanger bearings especially for screw conveyor service. Permanently sealed and lubricated for life, these self-aligning bearings require minimum power, while their

compact Meehanite housings offer minimum obstruction to flow of material.

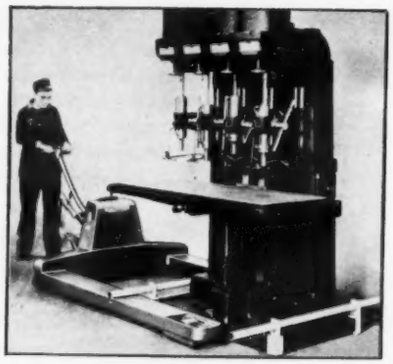
All parts are specially treated to resist rust. Bearings are available in shaft sizes from $1\frac{7}{16}$ to $2\frac{3}{16}$ in.

Skilsaw Half-Inch Drill Has Anti-Friction Bearings

A ½-in. drill equipped with anti-friction bearings throughout has been developed by Skilsaw, Inc., 5033 Elston Ave., Chicago, Ill. This Model No. 80 drill weighs only 8 lb., is 11½ in. long, and measures 9¼ in. high. Compact construction permits use in



close quarters, while die-cast body combines greater strength with lighter weight. Helical gears promote smooth performance. The drill develops a no-load speed of 450 r.p.m. and a full-load speed of 300 r.p.m.

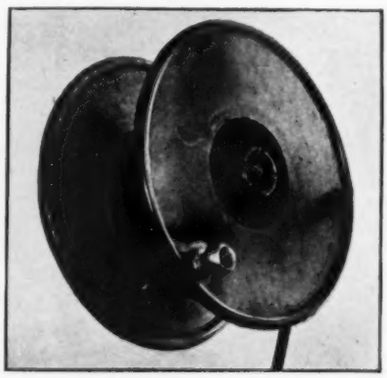


Lewis-Shepard Hydraulic Truck Helps in Moving Machine Tools

The Lewis-Shepard Sales Corp., 245 Walnut St., Watertown, Mass., has developed an open-end hydraulic lift truck especially adapted for moving massive top-heavy machine tools. This truck is claimed to provide speed and safety in raising and lowering the loads, as it has extra-wide spreading arms, special levers for picking up heavy objects, and other features for added safety and convenience.

Schramm Live Hose Reel Handles Air or Water

A new type of live hose reel developed for use with either water or compressed air has been made available by Schramm, Inc., West Chester, Pa. These reels, which are available in

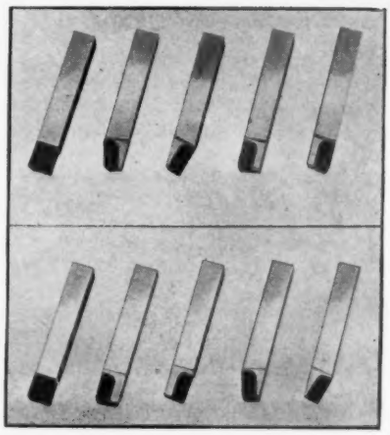


either wall or tank mounting types, are designed so that 3 ft. or the entire 50 ft. of hose can be unreeled and the valve then opened.

Valve is built inside the reel and is made of standard valve parts. It is self sealing, with no adjustments, packings or stuffing boxes. Reel side numbers are spun and welded to hub for extra strength. Heavy bronze bushings support the reel.

Standard Carbide Tools Offered by Carboloy

Manufactured on a mass-production basis, a line of standard cemented-carbide tipped cutting tools has been introduced by Carboloy Co., 11149 E.



Eight Mile Rd., Detroit, Mich. In addition to covering, in five standard styles and three grades, the majority of all turning, boring and facing applications, these standard tools are also capable of simple conversion, by the purchaser, into hundreds of 'special' tools, thus obtaining such tool forms at a total cost only a little more than new standard tools.

Shown are two complete sets of tools—one for cast iron and one for steel—in one of the seven sizes in which these are available. Ready differentiation between tools designed for steel cutting and those intended for machining cast iron is provided by coloring the shanks.

Introduction of a standard line of Carboloy tools for machining steel has been facilitated by development of a general purpose grade for steel cutting. Tools made of this grade (78B) will stand more abuse than those of the 78 grade, while they also have greater resistance to abrasion than the 78A grade. They are designed to take cuts up to ½ in. deep at feeds up to 0.030 in. For machining cast iron, the standard tools are available in two optional grades.

"Welco" Push-Pull Motor Exerts 4,000-Lb. Thrust

B. A. Wesche Electric Co., 1622–1628 Vine St., Cincinnati, Ohio, has developed a type of thrust mechanism which translates revolutions into

practical, powerful straight line motion, delivering a thrust up to 4,000 lb. Being entirely mechanical, with the thrust bar connected direct through differential gearing to a powerful torque motor, this "Welco" push-pull motor is not restricted to vertical or semi-vertical mounting.

They Don't "Run Me Ragged" Anymore with this new Pipe Machine on the job

and the whole plant saves TIME and MONEY with the

OSTER

Pipe Master THE NEW LOW COST PORTABLE PIPE-THREADING MACHINE!

As easy to move as a wheelbarrow and operating from the ordinary light socket, the "Pipe Master" brings the pipe shop to the job.

No more running back to the pipe shop to cut threads to fix those pipe-line breakdowns. That's where you save time and keep the maintenance department abreast of the production department because the "Pipe Master" goes anywhere it is needed, in the plant. Handling all sizes from ¼" to 2" through its spindle and driving geared threaders and cutters up to 6" . . . 90% of all your work is done by this handy machine.

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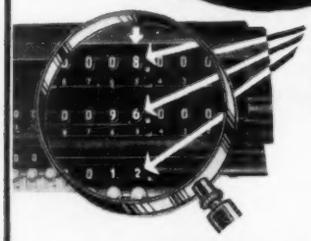
Tilting and Mounting Angles
and other uses!



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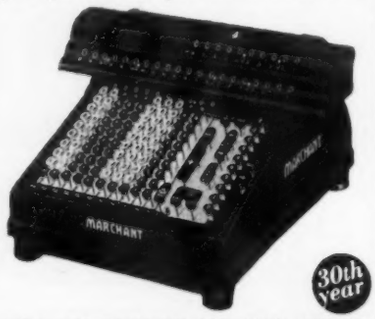

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Use margin of page if necessary.

It can be used horizontally, upside-down or in any conceivable position. Also, since the motor is reversible, a pulling motion of equal force to that of the thrust is available.

Improved Center Point Lube Needs Only One Application

Based upon initial developments in 1937, Chicago Mfg. & Distributing Co., 1936 W. 46th St., Chicago, Ill., has developed an improved lathe center point lube having the consistency of the No. 2 grease. With this lubricant it is claimed that only one application is required for any one job being turned in the lathe. Thus there is no lost time for stopping to relubricate the work, precision work is promoted because the lathe center can be drawn up more snugly, and less power is required to operate the lathe. It is further claimed that it is not necessary to use high speed steel lathe centers when using this lubricant.

G. E. Inkless Recorders Include D. C. Instruments

The Type CF line of inkless recorders developed by General Electric Co., Schenectady, N. Y., (*AM*—Vol. 83, page 272), has been extended to include direct-current instruments. Voltmeters, ammeters, millivoltmeters, milliammeters, and microammeters are available. Identified as the CF2 line, the d.c. instruments make it economical to apply recording instruments to many applications where previously the expense of suitable equipment could not be justified. Because of their inkless operation, they are suitable for general testing purposes and for use on moving vehicles. The recorder is portable and is suitable for either indoor or outdoor applications. It makes possible continuous operation for 30 days without attention, and may be operated at temperatures from —10 to 120 F.

"Markal" Solidified Paint Marks Hot or Cold Surfaces

A solidified paint in stick form, which can be used for marking either hot or cold surfaces, has been developed by Markal Co., 6 E. Lake St., Chicago, Ill. Known as "Markal A", this material is especially adapted for marking cold metal parts which require subsequent heat-treatment up to 1600 F. The part can be immersed in either oil or water immediately after heating without impairing the legibility of the marks. Available in white only, it is claimed not to flow, run, char, nor discolor. It is also claimed the markings adhere tenaciously to the metal, and will withstand all weather conditions without chipping, peeling or cracking after the surface has cooled.

Square D "Multi-breakeR" Protects 3 Phase Circuits

Square D Co., Detroit, Mich., has announced the Type M "Multi-breakeR" for use on 3-phase, 4-wire, solid-neutral a.c. circuits of 120-208 volts. When an overload occurs on any one pole, all poles trip simultaneously. Breakers are trip-free and cannot be held closed on a short or overload. Indicating units are calibrated and sealed at the factory so that intended capacities cannot be exceeded. Capacities range from 15 to 100 amp.

U. S. Rubber Develops Synthetic Rubber Clothing

Synthetic rubber clothing providing superior protection for industrial workers has been developed by United States Rubber Co., 1230 Sixth Ave., New York, N. Y. This clothing, made of "Synthal," resists oils, greases, acids, alkalies, and similar chemicals. It is also strongly resistant to most enemies of natural rubber, such as heat, sunlight and aging. All seams of the garments are vulcanized, doing away with stitch holes which formerly were a means of penetration.

NEW MATERIALS

"Deltabeston" Aircraft Wire Announced by General Electric

"Deltabeston" light weight small diameter aircraft wire which can be used to carry power to any part of a plane with safety has been announced by the Appliance and Merchandise Department of the General Electric Co., Bridgeport, Conn. This wire can be used for storage battery leads, circuit wiring for lamps, instrument wiring and other similar applications. It is flame-proof, highly resistant to heat, oil and moisture, and is available in sizes from No. 22 to 2/0, inclusive.

Metal Finish Produces Grain at High Speed

A finishing schedule that greatly reduces the time required for grain work is announced by Maas & Waldstein, 438 Riverdale Ave., Newark, N. J. In this schedule a special speed primer is used as the base coat. This coat will dry out of dust in five minutes and is ready to receive the graining ink within an hour. After the ink is dry, good results can be obtained by using a clear air-drying lacquer as the top coat and eliminating baking. For a more durable finish, clear "Codur" baking lacquer is recommended for the top coat. This finish can be baked thoroughly in 30 minutes at 275 F.